Work package 4

Deliverable: D4.4 Report proposing strategies in support of human capacity building and skills development

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The main outcomes

- As an enabler for science impact, Human Capacity and Skills Development (HCSD) is an essential component of the future BANOS framework. It covers discipline-specific skills as well as transferable skills. It focuses on formal degrees, short-term, vocational educational training, lifelong-learning and continuous professional development and includes transdisciplinarity, internationalisation and industry collaboration.
- The report identifies relevant policy initiatives and processes concerning HCSD in a global, sea basin and European context and builds on existing experiences at global and EU level and needs assessments at national and sea basin scale. It explores innovative approaches in training and education. It aims at training and skills development in crosscutting science-impact enablers (knowledge transfer, open science, open data and research data management practices (FAIR), citizen science in research…).
- The HCSD strategy articulates at three levels: a) Thematic/disciplines (SRIA); b) Skills required in the context of research and Innovation impact enablers; and c) Transferable and interpersonal skills. Recommendations are formulated at different levels: a) Broader policy level (global/EU/sea basin); b) BANOS Programme level (generic/strategic); and c) Project or action level (theme-specific)
- At a call/project level, the HCSD plan will provide guidance for the practical implementation of the strategic objectives of the BANOS HCSD Strategy. Guidance and templates for HCSD plans should not be prescriptive, rather as instruments to stimulate and promote the uptake of the strategic objectives of the HCSD Strategy. A number of criteria and elements that may be considered for inclusion in HCSD plan guidance/templates, are included as guidance or suggestions to this discussion.

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Description of task: (i.e. as in the Description of Work)

The future BANOS programme contribution to human capacity building and skills development in relevant scientific and innovation areas needs to be straightforward and aim for impact. In the scope of the ongoing BONUS Art 185 some work in this area has been done – both at project specific level (PhD, postdoc projects, technical courses and summer schools in cooperation with academia), and at programme level (seminars and training on young scientists' transferable skills in the remit of the popular BONUS Young Scientist Club).Through capitalising on the previous experience of the strategic partners (e.g. ICES, JPI-Oceans..), in close consultation with competent stakeholders, such as the European Marine Board and the IODE Project Office for IOC-UNESCO, and based on recommendations and insights from strategic documents and diagnostic tools (e.g. Marine Training inventory EMBC+, EMB Science Brief on Marine Graduate Training), coupled up with the ongoing BONUS Art 185 programme's legacy in this area, VLIZ will develop a strategy in support of human capacity and skills development. To this purpose, the BANOS CSA will explore and build further on the best practice among the participating NFIs. The task will map what skills and competences are most needed in specific areas, identify bottlenecks and propose suggestions for improvement. It will seek to engage Graduate Schools in the process in order to provide a long-term solution and train the next generation of marine researchers with the right balance of academic and "soft skills" needed to address societal challenges & blue growth objectives. The task will address all aspects of the future BANOS programme, and the strategic recommendations will cover training and skills development in areas going from knowledge transfer, open science, open data and research data management practices (FAIR data), to the inclusion of citizen science in research. Creation of strategies in support of the future programme's HCB and skills development will commence in M6; by M12 a draft document for consultations with the programme's stakeholders will be produced, and the final report submitted in M18 (SOW, the 2nd Project Assembly).

BALTIC AND NORTH SEA COORDINATION AND SUPPORT ACTION (BANOS CSA)

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Task 4.3. Strategies in support of human capacity building and skills development

REPORT

BALTIC AND NORTH SEA COORDINATION AND SUPPORT ACTION (BANOS CSA)

Task 4.3

Strategies in support of human capacity and skills development

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Contents

Executive summary

The Baltic and North Sea Coordination and Support Action (BANOS CSA) provides the preparatory framework for the future joint Baltic Sea and North Sea Research and Innovation Programme (BANOS). As an enabler for science impact, Human Capacity and Skills Development (HCSD) is an essential component in this framework. **HCSD is the process of strengthening the abilities or capacities of individuals, organisations** and societies to solve their problems and meet their objectives on a sustainable basis. It covers **discipline-specific skills as well as transversal or transferable skills**. It focuses on formal degrees, short-term, vocational educational training, lifelong-learning and continuous professional development.

- The BANOS HCSD Strategy focuses on different aspects of HCSD, including **cross/trans-disciplinarity, transferable skills, internationalisation, industry collaboration, continuous professional development and life-long learning**. It aims for a long-term strategy to ensure appropriate academic and soft skills for the next generation of marine scientists. The strategy **builds on existing experiences at global and EU level** (offer) and **needs assessments** (demand) at national and sea basin scale. It **explores innovative approaches** in training and education (MOOCs, webinars, internships, e-learning, activity-based-training, summer schools etc.). It aims at training and skills development in **crosscutting science-impact enablers** (knowledge transfer, open science, open data and research data management practices (FAIR), citizen science in research…). The HCSD strategy aligns with other tasks of BANOS CSA, and specific HCSD needs as identified through the **BANOS Strategic Research and Innovation Agenda**.
- Whether an early-career researcher, an established researcher or somewhere in the middle, skills development has a critical part to play in employability and career development. While **research and professional skills** development have relevance to science and technology, **transferable skills** development enhance researchers and technicians in their roles in innovation, leadership and influencing across academia, public and private sectors.
- The Global Ocean Science Report **(GOSR) is an important resource for analysis of marine science capacity at regional scale**. The Baltic and North Sea marine research and innovation partnerships can use this instrument to inform sea basin strategies. Conversely, sea basin partnerships could proactively contribute to the relevance and impact of the future GOSR editions: by **co-designing future editions, suggesting relevant elements for the purpose of analysis at relevant scale and by ensuring a coherent and coordinated response at national level.**
- For now, the CD-survey and GOSR2020 are the **best available systemic approach for assessment of capacity development needs in marine R&I** and can serve as a broad guidance. They are dynamic instruments that can be further developed in co-design.
- To provide a broader context for HCSD in a marine and maritime context, the present study included a systemic literature review, assessing the number and diversity of peer-reviewed publications dealing with capacity development, training and skills. One third of these publications addressed the need of CD and training to professionals to increase maritime safety, often involving simulators-based training and infrastructures (34%). Nearly 1 out of 4 publications focused on new skills and aspects of training that are not part of traditional curricula in academic or higher education/ formal degrees. Data-management, knowledge transfer, communication, insights in socio-economic, policy, and governance aspects in the ocean and maritime environment are often mentioned in this context and **need for 'new skills for a blue agenda'**. The need to apply transdisciplinarity in HCSD is advocated from perspectives such as marine spatial planning, sustainable development, integrated coastal zone management and management of marine protected areas.
- Building on existing insights: i**n total, >60 organisations and/or capacity development initiatives were consulted. Sixteen (16) BANOS strategic partners** were consulted on their CD activities and approaches (including OSPAR, HELCOM, ICES, JPI-Oceans, JPI-Climate, EuroMarine, European Marine Board and IOC-UNESCO). **Targeted in-depth interviews** were conducted with key resources. In-depth research on secondary sources was conducted on the **EMB publication 'Training the 21st Century Marine Professional'**. Through the interviews and desktop study, strategic partners identified additional relevant resources as context and resources for the future BANOS HCSD strategic framework
- **Best practices in global and EU context:** besides global/multi-lateral HCSD initiatives implemented under **SCOR, POGO and IOC-Ocean Teacher**, examples of 'best practice' at EU and national/local level are included to illustrate the diversity of approaches.
- **The Marine HCSD landscape is a multi-stakeholder environment:** a broad range of tools and approaches implemented by the BANOS (strategic) partners and their networks was collected in a 'resource table' and provides a link to first-hand experiences for each particular tool or approach**. It is worth noting that examples of co-design development/implementation exists for nearly all types of tools. The co-design make up the largest part (37%) of the 'best practice' examples put forward** in the resource table.

- The future BANOS Programme **scope on HCSD will articulate at three main levels: a) Thematic/disciplines,** as identified by the co-designed Strategic Research and Innovation Agenda **SRIA; b) Skills** required in the context of **research and Innovation impact enablers;** and **c) Transversal/Transferable and interpersonal skills.**
- **The recommendations** included in this section were formulated based on interviews with a wide range of stakeholders and experts sources in the area of HCSD. They **build on existing insights and recommendations from capacity development initiatives**. The recommendations require further discussion within the consortium and partnership to select and prioritise the desired features of the future BANOS HCSD Strategy. **Recommendations are formulated at different levels: a) Broader policy level** (global/EU/sea basin); b) **BANOS Programme level** (generic/strategic); and c) **Project or action level** (focused/theme-specific)
- At a call/project level, the **HCSD plan will provide guidance for the practical implementation of the vision and strategic objectives of the BANOS HCSD Strategy**. Guidance and templates for HCSD plans should not be prescriptive, however should be seen **as instruments to stimulate and promote the uptake of the strategic objectives of the HCSD Strategy.** Developing detailed guidance or templates for these HCSD plans is not the remit of the present Task and further discussion within the consortium and main partners, to inform and advice decision-making processes at national level (national R&I and funding agencies) are *conditio sine qua non*. A number of criteria and elements that may be considered for inclusion in HCSD plan guidance/templates, are included as guidance or suggestions to this discussion.

1. Introduction

1.1. Context

The Baltic and North Sea Coordination and Support Action (BANOS CSA) is preparing a framework for the joint Baltic Sea and North Sea Research and Innovation Programme (BANOS), to be ready in 2021. In line with the Europe 2020 strategy for a smart, sustainable and inclusive economy in Europe, knowledge and innovation are considered to be of central importance to the generation of sustainable blue growth. As an enabler for science impact, Human Capacity and Skills Development (HCSD) is an essential component in this framework.

The BANOS HCSD Strategy focuses on different aspects, including cross/trans-disciplinarity, transferable skills, internationalisation, industry collaboration, continuous professional development and life-long learning. It aims for a long-term strategy to ensure appropriate academic and soft skills for the next generation of marine scientists. The strategy builds on existing experiences at global and EU level (offer) and needs assessments (demand) at national and sea basin scale. It explores innovative approaches in training and education (MOOCs, webinars, internships, e-learning, activity-based-training, summer schools…). It aims at training and skills development in crosscutting science-impact enablers (knowledge transfer, open science, open data and research data management practices (FAIR), citizen science in research…). The HCSD strategy aligns with other tasks of the BANOS CSA project, and specific HCSD needs as identified through the Strategic Research and Innovation Agenda.

Task 4.3 is part of BANOS CSA work package 4: *Specific measures reinforcing future programme's lasting impact*. Three other tasks within BANOS CSA WP4 directly share the role of science impact enablers and the 'open approach' with task 4.3. Specifically, Task 4.4. *Developing strategies and instruments supporting open data* and Task 4.6. on *Strategies supporting firm establishing of 'open science'* deal with open access to scientific knowledge and technology; Task 4.5 *Developing strategies and instruments stimulating innovation diffusion and 'open innovation'* deals with knowledge sharing in the innovation process. The contents of these tasks were carefully attuned to one another in order to produce a trio of synergetic reports covering strategies for the sharing of research and innovation outcomes.

The BANOS HCSD Strategy does not start from scratch: it builds further on the experiences within the consortium, of its strategic partners and its broader network. It adds new insights from recent literature and seeking coherence with new policy initiatives at the European level.

The reference terms for Task 4.3. include:

- Propose a long-term strategy to ensure appropriate academic and soft skills for the next generation of marine scientists
- Formulate strategic recommendations on HCSD in areas going from knowledge transfer, open science, open data, open innovation, to the inclusion of citizen science in research
- Identify bottlenecks and gaps for improvement such that strategic recommendations can be made. Include transversal aspects of this work. Zoom in on the local and practical aspects of HCSD
- Align and interact with other tasks, taking input from tasks and deliverables including: D1.1 Report defining scope of the future BANOS Programme; D1.2 Overview of existing priorities, status and capacity in relevant fields of research and innovation; T4.5 strategies and instruments for innovation and workshop on innovation aspects, and results from tasks on research synthesis (T4.2), open science (T4.4), citizen science (T4.7) and open data (4.6)

1.2. Introduction: concepts and definitions

Capacity development is defined in a variety of ways depending on the focus and framework. **Box 1** includes the most common concepts used in specialised literature with a commonly accepted definition, and sources for alternative definitions in literature. An overview of definitions and associated concepts is included as additional source material and can be accessed through www.banoscsa.org (BANOS web source).

Capacity Development in general is defined as the process through which individuals, organisations, and societies **obtain, strengthen, and maintain their capabilities** to set and achieve their own development objectives over time.

It is organised at different levels (see figure 1):

- Individual (student, professional)
- Organisation (institution, programme, project)

- Societal level (policies, management, instrument)

May cover different aspects:

- Knowledge; Skills
- Systems; Structures; Processes
- Values, Resources and Powers

And includes interrelated dimensions:

- Development of individual skills
- Effective organisations within which individuals can work
- Strengthening of interrelationships between entities
- Enabling environment for addressing relevant cross-sectoral issues

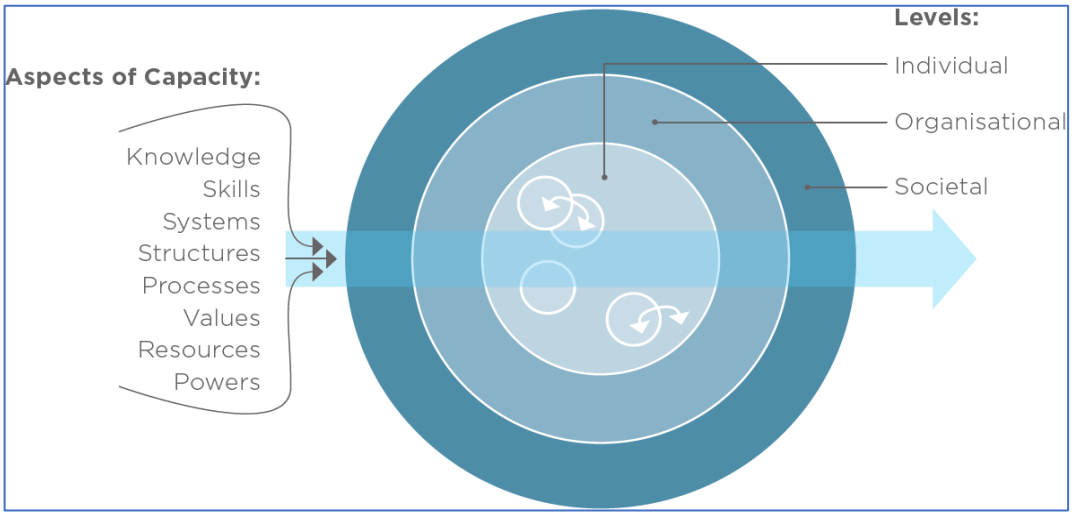


Figure 1: Capacity development as holistic approach to strengthening the capacity of individuals, organisations, and society (Shackeroff et al. 2016)

'Discipline specific' and 'transferable' (transversal) skills

Whether an early-career researcher, an established researcher or somewhere in the middle, skills development has a critical part to play in employability and career development. Doctoral degrees are outstanding academic qualifications, however, they do not prepare researchers for all skills required to develop a career in a working environment also outside of academia. Skills development is both about 'discipline specific' and 'transferable' professional skills (figure 2). Both are needed to improve the quality of a researchers' output and to enhance employability in a wider array of sectors. While research and professional skills development have relevance to science and technology, transferable skills development enhance researchers and technicians in their roles in innovation, leadership and influencing across academia, public and private sectors (MASTS 2021).

Transferable or transversal skills are a broad set of skills that are not specifically related to a particular role but are critically important skills that can be used in a wide variety of situations. E.g. in the context of FAIR and Open Science (see 'impact enablers' below), these include digital literacy/proficiency as well as skills related to communication, ethical and legal aspects (data protection, intellectual property (IP) licensing etc.) (EOSC 2021).

Box1: Overview of concepts and (proposed) definitions in Human Capacity Building and Skills Development

CONCEPT	SOURCES	DEFINITION(s)
Capacity	(UNDP 2009); (WMO 2015)	**What is "capacity"** Ability of individuals, institutions and societies to perform functions, solve problems, and set and achieve objectives in a sustainable manner. Often defined in terms of functional, individual, organisational, technical and adaptive capacity, as well as the enabling environment. At an individual level it refers to the skills, experience and knowledge that are vested in people; at organisational level it comprises the internal policies, arrangements, procedures and frameworks that allow an organisation to operate and deliver on its mandate.
Capacity building; Capacity development	(WMO 2015) (UNDP 2009) (UNCED, 1992)	**Is there a difference between "capacity building (CB)" and "capacity development (CD)"** The concepts are often used interchangeably. However, specialised literature refers to CB as "The process of building capacities, based on the assumption that there are no capacities to start from". This approach is considered to be less comprehensive than CD. A process that supports only the initial stages of building or creating capacities and assumes that there are no existing capacities to start from.
Capacity development	(Godfrey et al. 2002); (JICA 2007) (OECD 2009); (GTZ 2009); (UNDP 2009); (WMO 2015); (Shackeroff et al. 2016);	The process through which individuals, organisations, and societies **obtain, strengthen, and maintain their capabilities** to set and achieve their own development objectives over time. It covers different aspects (see figure 1: Knowledge, Skills, Systems, Structures, Processes, Values, Resources and Power) and includes interrelated dimensions: • Development of individual skills • Effective organisations within which individuals can work • Strengthening of interrelationships between entities • Enabling environment for addressing relevant cross-sectoral issues
Joint (research) capacity building; Research Capability Strengthening	(Segrott, McIvor, and Green 2006) (Nchinda 2002)	Building capacity of early career researchers with a focus on **conducting interdisciplinary and trans-disciplinary** research at the transnational level (e.g. co-supervision). Research capability strengthening consists of two main closely inter-related and inter-dependent activities, which, together, form the basis of institutional development: - improving, through appropriate training, the capabilities of scientists to undertake quality research - providing institutional support, equipment, supplies and other logistic support to the institution in which the trained scientists have to work
Transferable skills	(European Science Foundation 2010) ; (Vincx et al. 2018)	**Transferable skills** are skills learned in one context (for example research) that are useful in another (for example future employment whether that is in research, business etc.). They enable subject- and research related skills to be applied and developed effectively. Transferable skills may be acquired through training or through work experience.
Technology transfer; Organisational Knowledge Transfer	(Ockwell et al. 2008); (van Wijk, Jansen, and Lyles 2008);	Vertical **technology transfer**: the transfer of technologies from the R&D stage through to commercialisation. Horizontal technology transfer: the transfer from one geographical location to another. Organisational knowledge transfer refers to the process through which organisational actors – teams, units, or organisations – exchange, receive and are influenced by the experience and knowledge of others. It manifests itself through changes in the knowledge bases or performance of recipients.
Continuous Professional Development	(Vincx et al. 2018)	**Continuous Professional Development (CPD)** applies to those learning and development activities that contribute to an individual's continued effectiveness as a professional. CPD involves taking part in less-structured, more job-specific activities such as on-the-job learning or mentoring. CPD uses the principles of reflective analysis where upfront questions can be asked to determine the value of an activity.
Education 4.0	(Ernst & Young LLP and FICCI 2018)	Places the student at the centre of the ecosystem and shifting the focus from teaching to learning; primarily driven by four key levers that would help redefine the present higher education system: employability, student experience, research excellence and society.
Lifelong learning (LLL)	EU Commission LLP 2007-2013, Europe	Education, vocational education and training, non-formal education and informal learning undertaken throughout life, resulting in an improvement in knowledge, skills and competences within a personal, civic, social and/or employment-related perspective. It includes the provision of counselling and guidance services.
Vocational Education and training (VET)	OECD 2009	Education and training programmes containing both knowledge (theoretical understanding) and practical skills, designed for, and typically leading to, a particular job or type of job.

See UNEVOC-UNESCO **TVETipedia for an exhaustive glossary** of terms that are commonly used in the area of Technical and Vocational Education and Training. https://unevoc.unesco.org/home/TVETipedia+Glossary/

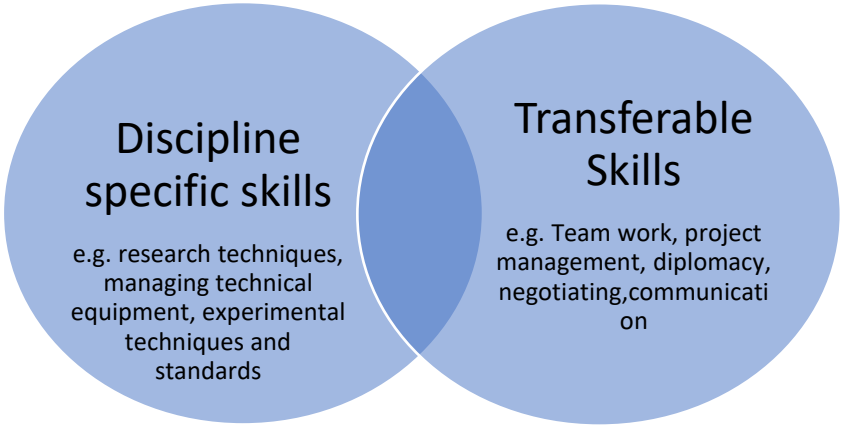


Figure 2: Discipline-specific versus transferable and professional skills (modified after MASTS)

HUMAN CAPACITY DEVELOPMENT

Is the process of strengthening the abilities or capacities of individuals, organisations and societies to solve their problems and meet their objectives on a sustainable basis. It covers discipline-specific skills as well as transversal or transferable skills. It focuses on formal degrees, short-term, vocational educational training, lifelong-learning and continuous professional development.

- It is an ongoing, continuous improvement process with feedback mechanisms rather than a short-term intervention
- It aims to augment capacity in a sustainable manner
- It includes the activities, approaches, strategies and methodologies that help organisations, groups and individuals improve their performance and generate development benefits
- It is an endogenous process driven by national mechanisms and facilitated by external agencies
- It should be evaluated in terms of the growth of capacity as a whole and over time

2. Capacity Development in Ocean Science: Global Perspective

2.1. IOC and Capacity Development in the 'Ocean Decade'

The UN Decade of Ocean Science for Sustainable Development (2021–2030) **(the 'Ocean Decade')**, coordinated by the Intergovernmental Oceanographic Commission (IOC) aims at transforming ocean science capacities with the purpose to improve preparedness in addressing the growing challenges related to the Sustainable Development Goals (SDGs, Agenda 2030). The quality of ocean science outcomes strongly depends on human resources and technical infrastructure supported by appropriate financial means. This is the focus of the SDG target 14.a on scientific knowledge, research capacity and transfer of marine technology. To achieve this target, countries around the world are investing in the development of human and technical capacities both at national level and through partnerships at local, national, regional and global levels.

- The **IOC Group of Experts on Capacity Development** **(IOC GE-CD)** assists the global and regional programmes with the implementation of capacity development (CD) needs assessments, the development of related work plans, mobilisation of resources, and provide advice on relevant methods and tools to deliver CD (IOC Capacity Development Strategy 2015-2021; **IOC/INF-1332**). The Group also advises on the implementation of a 'Transfer of Marine Technology Clearing House Mechanism (CHM)' as requested by the IOC Criteria and Guidelines on the Transfer of Marine Technology (**IOC/INF-1203**), making use of existing data and information systems already available at IOC and partners. This CHM is currently in development and launched as the Ocean Infohub.
- The **IOC Ocean InfoHub (OIH)** streamlines access to ocean science data and information for management and sustainable development. The OIH establishes a network of regional and thematic nodes that improves online access to and synthesis of existing global, regional and national data, information and knowledge resources. The OIH also aims at matchmaking services such as the identification of study and training or vessel survey opportunities, a peer-to-peer service to support scientific collaboration, and an automated/self-serve service to search for specific human or institutional expertise.
- The **Global Ocean Science Report 2020 (GOSR2020)** offers a global record and analysis of existing global ocean science capacities: human resources (including degree level, functions, gender and age distribution) (see Table 1-Theme 1), ocean science institutions, observation platforms, infrastructures, equipment, funding, investments, publications, data flow and exchange policies, capacity development needs (Theme 5) as well as national strategies on ocean science.

    - A total of 45 countries, responsible for 82% of ocean science publications over the time period 2010–2018, contributed data and information directly to the second edition of the GOSR (GOSR2020). This allowed analyses to be conducted at the global, regional and national scales.
    - In the GOSR2020, 'ocean science' encompasses natural and social science disciplines, including interdisciplinary approaches; the technology and infrastructure that supports ocean science; the application of ocean science for societal benefits, including knowledge transfer and applications in regions that are currently lacking science capacity; as well as science-policy and science-innovation interfaces.
    - The GOSR2020 is a resource for policymakers, academics and other stakeholders to assess progress towards the indicator for target 14.a.[1] and assess national needs and demands versus existing capacities (see also Table 1-Theme 5). It is an important building block for the global ocean science community to define its capacity development strategies, with special concern for the regional perspective including sea basin strategies.
    - The GOSR2020 is a dynamic process and will evolve over time. The analysis is based on the data submitted by Member States, hence the records are not always complete and comparisons are not always possible. In addition, the GOSR2020 analysis does not (yet) include information on the contribution to ocean science by the private sector. The complete information submitted by Member States is available via the GOSR2020 portal https://gosr.ioc-unesco.org (explore themes)
    - In the context of the Ocean Decade, capacity development takes a strong perspective of building equitable and equal access to marine technology and resources. Although often regarded as a matter of development cooperation, it is relevant for all countries to achieve the necessary ocean science capacity in view of the national and international commitments and the sustainability challenges ahead. **It is thereby equally important to address inequalities within regions and sea basins**. A number of conclusions can be drawn from this global-scale analysis, regarding the Baltic and North Sea countries and based on the country submissions (see overview Table 1 and section 3 'Stocktake').

[1] SDG target 14.a: 'Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology (TMT), in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries'

Table 1. Global Ocean Science Report GOSR 2020 Country submissions, by theme and year of sampling for the Baltic Sea: Denmark, Sweden, Germany, Finland, Poland, and Russian Federation (no submissions from Estonia, Latvia, Lithuania) and the North Sea: United Kingdom, Norway, Sweden, Denmark, Germany, the Netherlands, Belgium and France (in bold: countries that cover both sea basins).

Themes Country	(1)National research capacity & infrastructure	(2)Ocean science spending	(3)Ocean science governmental organisation and general information	(4)Oceanographic data and information exchange	(5)Capacity development and transfer of marine technology	(6)Sustainable development
Belgium	2013, 2015, 2017, (2019)	2013, 2014, 2015, 2016, 2017 (2019)	2019	2019	2019	2019
Denmark	2017, (2019)	(partial 2019)	2019	2019	2019	2019
Finland	2015, 2016, 2017, (2019)	2013, 2014, 2015, 2016,2017,(2019)	2019	2019	2019	2019
France	2016, 2017, (2019)	2017 (2019)	2019	2019	2019	2019
Germany	2013, 2014, 2015, 2016, 2017, (2019)	2013, 2014, 2015, 2016, 2017, 2019	2019	2019	2019	2019
Netherlands	2013, 2014, 2015, 2016, 2017, (2019)	2013, 2014, 2015, 2016,2017, 2019)	2019	2019	2019	2019
Norway	2013, 2015, 2017, (2019)	2011, 2013, 2015, 2017 (2019)	2019	2019	2019	2019
Poland	2013, 2014, 2015, 2016, 2017, (2019)	2013, 2014, 2015, 2016,2017,(2019)	2019	2019	2019	2019
Russian Federation	(partial, 2019)	2014, 2015, 2016, 2017, (2019)	2019	2019	2019	2019
Sweden	2017, (2019)	(partial, 2019)	2019	2019	2019	2019
United Kingdom	2013, 2014, 2015, 2016, 2017, (2019)	2013, 2014, 2015, 2016,2017,(2019)	2019	2019	2019	2019

- **The IOC Capacity Development surveys**

Capacity building is an essential tenet of IOC's mission. The IOC Capacity Development Strategy (2015) identifies capacity development as the primary catalyst through which IOC will achieve its four high level objectives in the current 2014–2021 IOC Medium-Term Strategy. The objectives of the IOC Group of Experts on Capacity Development is to **assist the global and regional programmes with the implementation of capacity development (CD) needs assessments, the development of related work plans, mobilisation of resources, and provide advice on relevant methods and tools to deliver CD**. In order to identify capacity development needs of IOC Member States the Group of Experts launched an online survey in 2018. The first survey focused largely on regional needs and those of Small Island Developing States (SIDS) and Least Developed Countries (LDC). The IOC CD needs assessment survey will be repeated every two years. The 2020 survey results were published online in April 2021 (www.ioc-cd.org). For the Baltic and North Sea regions, (partial) responses were submitted by only a restricted number of countries *(Estonia, Finland, France, Germany*) (see below).

The IOC Ocean Teacher Global Academy (OTGA) fosters collaborations beyond UNESCO/IOC to become the global 'training hub' for ocean sciences, including topics related to the management of the impact by and interactions with human activities. It addresses the needs for CD as identified by the 2030 Agenda and its SDGs and the UN Decade of Ocean Science for Sustainable Development. It also fully contributes to the implementation of the IOC CD Strategy, addressing key outputs identified in the strategy through increased support in the training activities of all IOC programmes. This support includes the Tsunami Unit, Ocean Literacy, and Harmful Algal Bloom programme, IODE, Ocean Sciences and the Ocean Decade, amongst others. Training topics include (active hyperlinks to training topics below):

- Scientific Knowledge and Research
- Sustainable Use of Marine Resources
- Marine Spatial Planning
- Marine and Coastal Ecosystems
- Disaster Risk Reduction
- Implementing International Marine Law
- Ocean Acidification
- Marine Pollution

An overview of courses and updates is available at: http://classroom.oceanteacher.org

The e-Learning Platform is an essential component of OTGA. As a fully-fledged Learning Management System (LMS), it facilitates face to face (F2F) classroom learning, blended learning and online learning. All training course contents are hosted on the OT e-Learning Platform, and OTGA has courses in 4 different languages (English, Spanish, French, Portuguese). The content is freely available during and after courses (Creative Commons Attribution 4.0 license), registration on the OT platform is mandatory. An alumni-network is established with post-training assessment and monitoring.

Global Network of OTGA Regional and Specialised Training Centres

OTGA develops a collaborative network of training centres that share education and training materials, staff and technical expertise, and provide cost-effective education and training services for the needs of IOC Member States. With involvement by the IOC Regional bodies, OTGA has increased focus on the capacity development needs of the regions by supporting the Regional and Specialised Training Centres. This network includes Regional (region-focused) and Specialised (topic-focused) Training Centres. Training topics includes tools that can help Member States achieving the SDGs as well as emerging topics. This OTGA global network of RTCs & STCs (see table 3) delivers customised training for ocean experts and professionals to increase national and regional capacity in coastal and marine sciences, services and management.

Table 2. An overview of Regional and Specialised Training Centres of OTGA

Department of Marine and Fisheries Sciences (DMFS), University of Ghana	*Institute of Oceanography and Environment (INOS), Universiti Malaysia Terengganu, Malaysia*	*Marine and Coastal Research Institute in Colombia (INVEMAR), Colombia*	*University of Uruguay (UdelaR)/University of Santa Catarina (UFSC), Uruguay/Brazil*
Indonesia Agency for Meteorology, Climatology and Geophysics (BMKG), Indonesia	*International Training Centre for Operational Oceanography (ITCOOcean), India*	*Centre for Marine Research and Technology (UEM), Mozambique*	*National Marine Data & Information Service (NMDIS)/National Center of Ocean Standards & Metrology (NCOSM), China*
UNESCO/IOC Project Office for IODE, Belgium	*Escuela de Ciencias del Mar, Argentina*	*Kenya Marine and Fisheries Research Institute (KMFRI), Kenya*	*International Tsunami Information Center (ITIC), USA*
Pacific Community (SPC), Fiji	*RTC-Portugal (Univ. Aveiro)*	*University of Bergen, Norway*	*Escuela Superior Politécnica del Litoral (ESPOL), Ecuador*

2.2. Scientific Committee on Oceanic Research (SCOR) and Capacity Development

The Scientific Committee on Oceanic Research (SCOR) is an international non-governmental organisation that supports international scientific activity and collaboration in all branches of marine research. By bringing together and upskilling the global marine science community, SCOR facilitates large-scale research projects and forms working groups focused on specific topics.

- The SCOR Committee on Capacity Building primary focus is to strengthen individual scientists' core skills and competencies for participating in interdisciplinary oceanic research. SCOR supports early-career scientists and researchers through a number of initiatives (see below).
- Research projects funded by SCOR also host **Summer Schools** that provide training to graduate students and early-career scientists on specific topics by combining classroom lectures, hands-on laboratory sessions, shipboard time and modelling experience.
- SCOR established an **evaluation and feedback mechanism** on its capacity building activities

Table 3. SCOR capacity development and supporting mechanisms

Resources for Students and Early-Career Scientists	Resources for Scientists and Institutions
• POGO/SCOR Visiting Fellowships • Nippon Foundation-POGO Centre for Excellence in Observational Oceanography • POGO Fellowships for Research Cruise Training • Regional Graduate Networks • Research Discovery Camps • Travel Support • SCOR Summer Schools	• SCOR Visiting Scholars • POGO Visiting Professors • Research Discovery Camps • Matrix of Capacity Development Approaches by International Organisations (see annex)

SCOR Capacity Development: mechanism

Proponents of SCOR Working Groups on specific Ocean research topics are required to include a section in their WG proposals on how they will address the issue of building capacity in their area of science through the work of their group. Working groups are requested to plan capacity-building activities that are best fit for purpose for the topic they address. This includes (but not limited to):

- Organise training events in conjunction with the WG meetings
- Invite (post)doctoral fellows or students to participate to the WG meetings
- Convene a training workshop or science conference separate from a WG meeting
- Produce on-line lectures, PowerPoint presentations, best-practice manuals
- Partner with other SCOR activities (e.g., research projects and infrastructural activities) to carry out capacity building
- Plan an event in conjunction with the SCOR Regional Graduate School of Oceanography in Namibia—SCOR Research Discovery Camp
- Encourage a WG member to serve as a SCOR Visiting Scholar through the SCOR Visiting Scholars

SCOR approach in ocean science capacity development focuses on increases in capability for research, observations, and institutional management and management skills. It can focus on individual, institution, national, regional, and international levels. Capacity building in SCOR is also a means for increasing participation of under-represented groups in ocean research and observations (gender, nations, generational and ethnic diversity).

2.3. Partnership for Observation of the Global Ocean (POGO) and Capacity Development

POGO aims on expanding international support for ocean observing, through innovation of the ocean observing system, capacity development and outreach/advocacy. The São Paulo Declaration of 2001 drew attention to the imbalance between Northern and Southern Hemispheres in the capacity to observe the oceans, recommending immediate action to enhance such capacity in developing countries. Since then, POGO has developed an array of training programmes targeted primarily at early-career scientists from developing countries with continued support to its alumni, particularly through the NF-POGO Alumni Network for Oceans (NANO) and its collaborative ocean observation projects.

POGO has developed an extensive shipboard training programme and a Visiting Fellowship programme, in partnership with SCOR. POGO also established the NF-POGO Centre of Excellence in Observational Oceanography.

- NF-POGO Centre of Excellence
- Shipboard training
- NF-POGO Alumni Network
- POGO-SCOR Fellowship Programme
- CofE Regional Training
- Austral Summer Institute

See https://pogo-ocean.org/capacity-development/.

2.4. HCSD in Marine Research and Innovation: Systemic Literature Review

To provide a broader context for Capacity Development in a marine and maritime context, we conducted a systemic literature review, assessing the number and diversity of peer-reviewed publications dealing with capacity development, training and skills. To this purpose, we conducted a query on the Web of Science in September 2020.

The query selected peer-reviewed publications with assigned author keywords (AK) "capacity development" OR "capacity building" OR “training” OR "human capacity development" OR "human resources" OR “skills”, as from 1999 up to the date of query. Additional geographic terms such as ‘Europe’, ‘Baltic’ or ‘North Sea’ were not applied in the query because to our experience (VLIZ marine research library services) they are often assigned or taken into account as ‘relevant’ by authors and hence do not yield representative outcomes.

This first AK-based search yielded 154,069 records. We combined these AK with a topic search (TS) for the terms “marine” OR “maritime” OR “ocean” OR “blue”, narrowing down the number of returned records 1,065. These ‘maritime’ articles represented less than 1% (0.7%) of all peer-reviewed publications dealing with capacity and skills development.

A manual screening of the 1,065 records aimed to identify those articles with following features: 1) aimed at human capacity and skills development HCSD; 2) focus on marine-maritime topic 3) targeting professional HCSD (academic and higher education, technical professionals).

After a manual search of the selected set (n=1,064), 614 records were excluded from the analysis for not dealing with capacity development, or ‘false positives’ (e.g. ‘capacity’ as in volume, ‘training’ as in ‘muscle training’); 417 of the total records were ‘non-marine’ (‘blue’ or ‘ocean’ used in different sense) and 959 records were considered not relevant for the purpose of the current analysis (e.g. ‘machine learning’, or ‘skills/training of a mathematical model’, or capacity development to a non-professional or technical target group).

A total of 99 records that complied with all selection criteria were screened manually for content and assigned key terms, which were clustered in categories (see figure 3) considered relevant for the analysis.

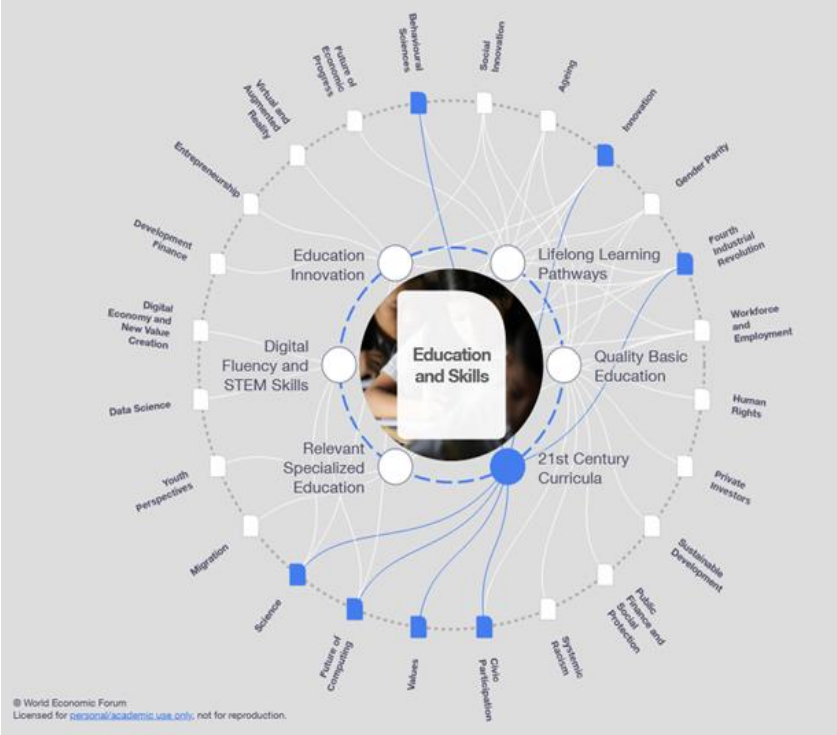
Box 2. WHY SKILLS AND NOT DEGREES: Skills - not educational qualifications - are becoming more valuable to employers; (based on article in World Economic Forum, Sept 2020) by Ravi Kumar (Infosys Ltd) and Steve George (Ernst & Young).

Challenge: The world is facing a reskilling emergency

The current decade is often called the “decade of delivery” because of the important transitions to move to a more sustainable world. This transition brings along an unprecedented and rapid rise of roles at the forefront of the data and Artificial Intelligence economy, as well as new roles in engineering, cloud computing and product development. These jobs need talent with relevant skills. The nature of work and careers is changing fast - and in the future, the right skills will be prized over academic qualifications alone.

Given the pace of the Fourth Industrial Revolution compared to those of the previous three, there is an uncomfortably short interval available to build the training systems and labour market institutions necessary to develop new skillsets. The AI & Machine Learning Imperative (MIT SMR guide, 2020), predicts a growing gap between the sophisticated tools companies can produce with technology, and the parts of these companies that can actually use the tools in production - due to a lack of skills. Enabling the three billion members of the global workforce to navigate this industrial revolution requires a greater variety of adult training and learning opportunities. Only about 11% of adults in the European Union aged between 25 and 64 were participating in education and training programs as of 2019 (European Association for the Education of Adults).

Gaining formal qualifications alone will not equate to successful re-skilling, however; lifelong learning opportunities such as modular short-cycle courses, experience on the job, and exposure to new projects are necessary to help more people gain the skills that match labour market demand. According to the OECD, closing the skills gap will require a solid understanding of the current skill base, proactive talent management strategies, and sustained dialogue among companies, governments and education providers.



The Fourth Industrial Revolution requires short-term reskilling to meet labour market demands.

According to OECD estimates, more than 1 billion jobs, that is almost one-third of all jobs worldwide, are likely to be transformed by the technologies of the 4th Industrial Revolution by 2030. The World Economic Forum estimates that 133 million new jobs in major economies will be created to meet these demands by 2022, while 42% of the core skills required to perform existing jobs are expected to change. In addition to high-tech skills, specialised interpersonal skills will be in high demand, including skills related to sales, human resources, care and education.

For generations, we have spent the first third of our lives acquiring the college degrees we need to find jobs. These degrees are the stamps on our professional passports that paved the way for the remaining two-thirds of our journey. It is no longer the case that the nature of our work, along with the skills and knowledge required to execute it, remains unchanged for a lifetime.

Interestingly, the future of work will not only be about hard skills; it will be about holistic job skills beyond task-oriented or technical skills. Skills such as eye for detail, creative problem-solving skills, a collaborative mindset and an ability to deal with ambiguity and complexity, can be acquired, often through apprenticeship programmes.

Modified from 'The World Economic Forum' CCA-NC-ND 4.0 International Public License.

The number or proportion of peer-reviewed articles on specific aspects of human capacity development cannot be considered as a proxy for the direct societal interest or conducted efforts, because often HCSD is addressed at national or institutional level and reported/evaluated through technical/internal reporting. However, the (change in) scientific output on HCSD is taken as a relative indication of change over the period and among broad categories.

One third of these publications addressed the need of CD and training to professionals to increase maritime safety, often involving simulators-based training and infrastructures (34%). Nearly 1 out of 4 publications focused on new skills and aspects of training that are not part of traditional curricula in academic or higher education/ formal degrees (24%). Data-management, knowledge transfer, communication, insights in socio-economic, policy, and governance aspects in the ocean and maritime environment are often mentioned in this context and need for 'new skills for a blue agenda' (see figure 3).

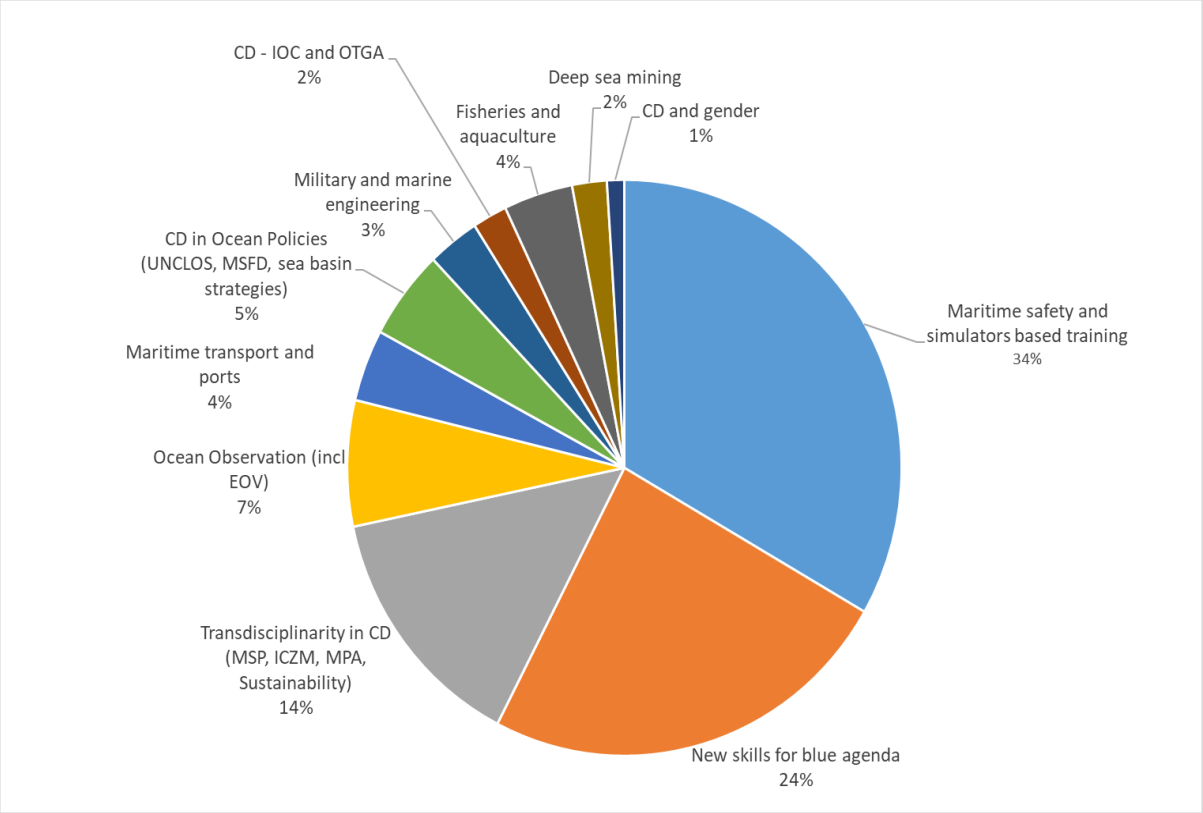


Figure 3: Capacity development for marine professionals addressed in peer-reviewed publications, according to topics and categories defined for the purpose of the literature review (WoS; 1999-2020)

The need to apply transdisciplinarity in capacity development, is advocated from the perspectives of processes such as marine spatial planning (MSP), sustainable development, integrated coastal zone management (ICZM) and management of marine protected areas (MPA) (14%). A transdisciplinary approach requires a holistic framework to problem solving, where natural scientists, geographers, sociologists, anthropologists, economists, historians, legal experts, political scientists, and other stakeholders can contribute to the understanding of nature-society interactions. The need for CD to professionals to enhance ocean observation systems, including the observation of essential (biological) ocean variables (EOV) is addressed by 7% of the selected articles.

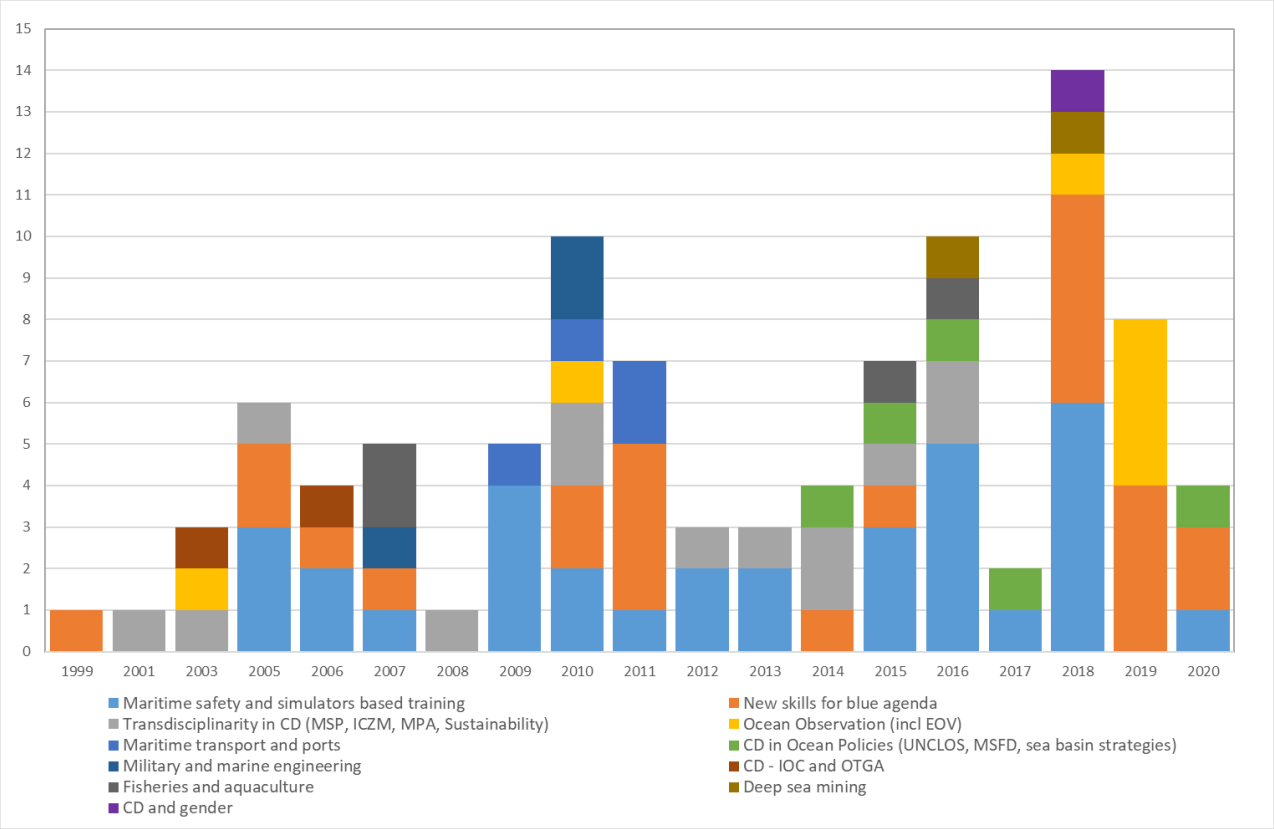


Figure 4: Capacity development for marine professionals addressed in peer-reviewed publications (WoS), according to topics and categories defined for the purpose of the literature review, by year of publication (1999-2020)

The data suggests a relative increase in the number of publications on HCSD over the period (1999-2020, figure 4). While some HCSD topics have been a subject of analysis since the beginning of the period (maritime safety, transdisciplinarity, new skills), HCSD seems to gain increased attention in others (e.g. HCSD in ocean policies).

2.5. HCSD in Research and Innovation: The skills agenda for Europe

Europe aims for a climate-neutral society by 2050. There are a number of scenarios to achieve this, all of which involve an increase in electricity production, *i.a.* to replace fossil fuels. A quarter of this is projected to come from offshore wind, which is expected to take up 5-10% of marine area in Europe, with particularly large developments projected in the North Sea and Baltic region. Similarly, large-scale investments are expected in aquaculture for food and biofuel purposes, as well as in other sectors (shipping, ports, fisheries, ocean observation, mineral extractions...). This implies a massive change in labour force and specialised skills (Shepherd DGMARE 2019, pers. comm.; and box 2 p.17). Shortages in skilled personnel and a skills mismatch is already well-documented in dedicated reports and analyses (e.g. MATES project, WindEurope etc. see below). The pace of change in the typology of the job market is accelerating. Job positions themselves also evolve faster during the time one employee holds that job and people switch jobs more frequently. This illustrates the importance of adaptability and life-long learning (J. Fionda, DGEMPL 2019, pers.comm.). Digital and green skills are crucial in this transition and the EU Green Deal and the Digital Strategy are important catalysts in the process.

European Skills Agenda as a broader framework in HCSD

The ***'European Skills Agenda for sustainable competitiveness, social fairness and resilience'*** (July 2020) brings together Member States, companies and social partners to improve the relevance of skills in the EU. The agenda sets quantitative targets for the upskilling (improving existing skills) and reskilling (training in new skills and lifelong learning) of jobs in the EU within the next 5 years. The EU Skills Agenda relies on EU budgets (including the EU NextGeneration and

Recovery Plan) as a catalyst to unlock public and private investment in people's skills. The Skills Agenda is a relevant transversal resource for HCSD in the EU and regional context, it has "12 flagship actions":

1. A Pact for Skills
2. Strengthening skills intelligence
3. EU support for strategic national upskilling action
4. Proposal for a Council Recommendation on Vocational Education and Training for sustainable competitiveness, social fairness and resilience
5. Rolling out the European universities' initiative and upskilling scientists
6. Skills to support the green and digital transitions
7. Increasing STEM graduates and fostering entrepreneurial and transversal skills
8. Skills for Life
9. Initiative on Individual Learning Accounts
10. A European approach to micro-credentials
11. New Europass Platform
12. Improving the enabling framework to unlock Member States' and private investments in skills

Skills intelligence leads to informed education and skills policies. In the EU this skills intelligence needed strengthening, which was addressed by implementing the Blueprint programme for Sectoral Cooperation on Skills. Under the blueprint, stakeholders work together in sector-specific but multi-stakeholder partnerships - **alliances for sectoral cooperation for skills -** to develop and implement strategies to address skills gaps in these sectors.

The first five **Blueprint Alliances (BA)** began their work in January 2018 (incl. maritime technology, space - geo information, tourism) followed by 10 additional BA in 2019/2020 (incl. maritime shipping, bioeconomy, new technologies and innovation in agriculture, energy value chain – digitalisation). In 2020/2021, six more Blueprint Alliances kicked-off (i.a. on blockchain, cultural heritage, cybersecurity, software services). BA promote the use of tools such as the European qualifications framework (EQF), the European skills, competences, qualifications and occupations (ESCO), Europass, and the European credit system for vocational education and training (ECVET) and European quality assurance in vocational education and training (EQAVET)

The **Europass framework** includes a big data analysis of skills needs, contributes to skills intelligence and provides information on trends in separate sectors. Europass keeps track of certification achieved through professional learning trajectories, whereas the 'Graduate Tracking' focusses on the transition from education to work.

Meeting the objectives of the Skills Agenda, requires substantial resources to be mobilised by aligning capacity and skills development objectives, through a number of EU instruments throughout 2021-2027. These include (but not limited to):

- European Social Fund Plus (budget of €86 billion)
- Erasmus+ (budget of €26 billion)
- Invest EU's Social Investment and Skills window (budget of €3.6 billion)
- New Digital Europe Programme (budget €9.2 billion) for advanced digital skills
- Recovery and Resilience Facility (powered by €560 billion in grants and loans) for upskilling and reskilling initiatives.

Although these instruments and funding mechanisms do not specifically focus on marine-maritime agendas, they can provide important resources, both inspirational and monetary, for the implementation of future HCSD strategies at local and regional scale. The EU initiatives build on the European Pillar of Social Rights (November 2017) and the Communication on a Strong Social Europe for Just Transitions (January 2020).

3. HCSD - Blue Careers in Europe

3.1. Introduction: HCSD in Ocean Research and Innovation

The gap in needs for an equitable access to capacity development and marine technologies is well-acknowledged in the context of the IOC-CD. The challenges defined through the **UN Ocean Decade to achieve 'the science we need for the ocean we want'** also address this 'human capacity and skills gap', in a context of sustainable development (hence broader than Blue Economy).

- The **EU Blue Growth Strategy**[2] identified the need for skilled and suitably qualified graduates in marine, maritime and engineering sciences in order to ensure innovation in Europe's Blue Economy. It acknowledges that blue growth will require an appropriately skilled workforce, able to apply the latest technologies in a range of disciplines.
- The '**Blue Careers in Europe'**[3] initiative refers to the mismatch between the knowledge and competences acquired throughout the educational path and those required on the job market in the maritime industries across Europe. There is a disconnection between marine graduate training priorities and the needs and expectations of future non-academic employers[4].
- In **The Rome Declaration**[5], the European marine science community acknowledges this by calling for "innovation in the provision of undergraduate and postgraduate training and enhancing skill sets and career pathways for marine professionals". The Declaration also stresses the need for education and training to foster trans- and cross-disciplinarity. There is broad agreement on the need to tackle this 'skills gap' in the marine and maritime sectors, and to do this in a EU-wide approach[6].

3.2. HCSD in Ocean R&I: Context for the Baltic and North Sea from GOSR 2020

3.2.1. Global Ocean Science Report

The GOSR2020 and future editions form part of monitoring and evaluation process to track the progress of the Ocean Decade in achieving its vision 'The science we need for the ocean we want' (see section 2.1.). The general findings of the GOSR are summarised as:

- Ocean science funding is largely inadequate, undermining the ability of ocean science to support sustainable provisions of ocean ecosystem services to humanity
- Ocean science continues to underrepresent women, particularly in highly technical categories
- The technical capacity of ocean science remains unequally distributed among countries and regions
- Ocean data and information are inadequately supported, which hampers open access and data sharing
- Ocean research has direct implications on sustainable development policies, management strategies, and action plans of multiple societal structures

GOSR is an **important resource for analysis at regional scale**. The Baltic and North Sea marine research and innovation partnerships, as is the case for other sea basins partnerships and consortia, can use this instrument to inform sea basin strategies. Conversely, sea basin partnerships could proactively contribute to the relevance and impact of the future GOSR editions: by **co-designing future editions, suggesting relevant elements in the survey for the purpose of analysis at relevant scale (e.g. regional seas or sea basin strategies) and by ensuring a coherent and coordinated response at national level.**

For now, the current GOSR2020 analysis can serve as a broad guidance, it is the **best available coherent and systemic approach for assessment of capacity development needs in marine R&I.** The outcomes for Baltic and North Sea countries are included below. Again, the quality of the analysis depends on the completeness and quality in the answers submitted by member states. Responses are formal, upon invitation by Circular Letter to the nationally appointed

[2] Communication from the Commission to the European Parliament, the Council, The European Economic and social Committee and the Committee of the Regions. Blue Growth opportunities for marine and maritime sustainable growth/* COM/2012/0494 final */

[3] 'Blue Careers in Europe' call under the European Maritime & Fishery Fund (EMFF) (C(2015) 8729 annex)

[4] DTU Aqua and IMAREST Case Studies, cited in the European Marine Board Future Science Brief. Vincx et al 2018.

[5] The Rome declaration, adopted 8 October 2014 at EUROCEAN Conference

[6] Blueprint for sectoral cooperation on skills: Maritime Technologies

delegates, and coordinated at national level by the IOC National contacts (NCP) or the IOC focal points (NFP) for capacity development.

GOSR includes 65 questions organised according to 6 themes (see table 1): National research capacity and infrastructure; Ocean science spending; Ocean science governmental organization and general information; Oceanographic data and information exchange; Capacity development and transfer of marine technology; Sustainable development.

Questions 52-60 refer to Theme 'Capacity development and transfer of marine technology'. There are no submissions from Estonia, Latvia and Lithuania. Not all questions were answered by the other 11 countries bordering North Sea and Baltic Sea (see tables and notes). Due to the low number of responses in the analysis, no data treatment was applied (weighted average or other).

Table 4. Q 52. Rank your country's top five specific capacity (development) needs (from 5 highest to 1 lowest).

country	Funding	Observation facilities and equipment	Human capacity, increase the number of ocean science personnel	Specialised technical (advanced) training in certain topics, training,	Sampling and analysis equipment	Equipment for in situ and laboratory observations, analysis and	Networking (community building) with colleagues	Computer and computer software, including models and modeling	Academic (higher) training, basic training in ocean science	Opportunities to share our experience at conferences	Internet connectivity
Belgium	0	3	1	5	2	0	0	4	0	0	0
Denmark	5	5	2	3	4	3	1	3	2	1	1
Finland	5	3	4	0	0	1	2	0	0	0	0
France	4	4	5	1	1	4	1	0	4	1	1
Netherlands	5	2	2	2	2	2	4	2	2	2	1
Norway	5	4	0	0	2	3	0	0	0	1	0
Poland	4	3	1	4	2	3	3	3	3	2	2
Russian Fed.	4	3	4	4	5	1	4	2	1	4	3
UK	3	1	3	1	1	1	1	1	1	1	1
Category total score	*35*	*28*	*22*	*20*	*19*	*18*	*16*	*15*	*13*	*12*	*9*

(no responses from Germany, Sweden)

➔ ***Increase in Funding and in Observation facilities and equipment were marked as highest need***

Table 5. Q53. Rank the following types of technical training courses with respect to your national capacity development needs (from 5 highest priority to 1 lowest priority).

country	Technical training for ocean science related to research activities	Technical training for ocean science related to ocean observation	Technical training for ocean science communication	Technical training for ocean science data management	Technical training for ocean science re. sustainable management
Belgium	4	2	2	5	1
Denmark	1	1	1	1	1
Finland	1	3	5	2	4
France	5	4	1	3	2
Netherlands	2	2	2	2	2
Norway	2	3	5	1	4

Poland	4	4	2	4	2
Russian Federation	5	5	5	3	4
UK	1	1	1	1	1
Category total score	*25*	*25*	*24*	*22*	*21*

(no responses from Germany, Sweden)

➔ ***All areas of proposed technical training were marked as needs, with emphasis on training for skills in research activities and ocean observation***

Q 54. How would you rank your countries access to national and international scientific literature and information (e.g. peer reviewed journals, data bases)?

➔ ***All 11 countries indicated a 'very good' to 'excellent access', except Russian federation ('fair')***

Q55. How many peer reviewed journals in national languages not indexed in Web of Science are published in your country?

➔ ***Most countries responded <5 (Belgium 5-10; Russia and UK >50)***

Table 6. Q 56. Does your country have special national efforts and mechanisms to absorb and keep graduates in ocean science related positions and activities (e.g. PhD programmes, young scientist funding resources, exchange programmes, early career support)?

Country	Y/N	Bilateral support or training scheme for ocean HCSD
Denmark	Y	did not specify but indicated they exist
Netherlands	Y	Final evaluation of the Dutch National Ocean and Coastal Research Program www.nwo.nl/binaries/content/documents/nwo/algemeen/documentation/application/alw/nationaal-programma-zee--en-kust-onderzoek-eindevaluatie/WEB+final+evaluation+ZKO.pdf
Norway	Y	• Personal Overseas Research Grants and extensions of fellowship periods for post-doctoral fellows with funding from the Research Council www.forskningsradet.no/en/Funding/UTENLANDSSTIPEND/1254027284466/p1184150364108?visAktive=true; • Young Research Talents www.forskningsradet.no/en/Young_Research_Talents_Unge_forskertalenter/1253994998424; • Personal Doctoral Research Fellowship www.forskningsradet.no/servlet/Satellite?c=Page&cid=1195592882947&pagename=ForskningsradetEngelsk%2FHovedsidemal; • Personal Post-Doctoral Research Fellowship www.forskningsradet.no/en/Personal_postdoctoral_research_fellowship/1195592882951 • In addition, the universities have own schemes • Several research institutes have own schemes to varying degree
Poland	Y	Interdisciplinary internship program for students of Earth Sciences https://oig.ug.edu.pl/studenci/program_stazowy_power/rekrutacja_na_staze
Russian Fed.	Y	There are various opportunities for PhD, young and early career scientist
Sweden	Y	did not specify but indicated they exist
UK	Y	NERC Fellowships; https://nerc.ukri.org/funding/available/fellowships/

➔ ***Seven countries report having special mechanisms in place for early career support to ocean researchers***

Q 57. Does your country have special national efforts and mechanisms to support female graduates and scientists in ocean science related positions and activities?

➔ ***From the 11 respondents, 3 countries (France, Norway, UK) report special mechanisms to support female graduates and scientists in ocean science. In the UK, the Dorothy Hodgkin Fellowship was put forward as example (https://royalsociety.org/grants-schemes-awards/grants/dorothy-hodgkin-fellowship/)***

Table 7. Q 58. What mechanisms are in place to facilitate the participation of outside national experts in your country's ocean science projects and policymaking?

country	There are none	Guest positions	Advisory capacity	Exchange programmes	Board memberships	Others
Belgium		X	X	X		X
Denmark		X				X
Finland			X		X	
France		X		X		X
Germany		X	X	X	X	
Netherlands		X	X	X	X	
Norway		X	X	X	X	
Poland		X	X	X		X
Russian Fed.		X	X	X	X	
Sweden			X			
UK		X	X	X	X	
Total		*9*	*9*	*8*	*6*	*4*

➔ ***Guest positions, Advisory roles and Exchange programmes are most common reported mechanism to facilitate international participation in projects and policymaking***

Table 8. Q 59. Does your country take part in bilateral support/training to increase scientific training in ocean science related capacities, e.g. Fullbright scholarships, EEA and Norway Grants (EØS-midlene), Fish for Development and civil society 2018-2022?

Country	Y/N	Bilateral support or training scheme for ocean HCSD
Belgium	Y	Belgium has some bilateral agreements; www.belspo.be/belspo/coordination/bicoop_en.stm
Denmark	Y	Marie Curie; https://ec.europa.eu/research/mariecurieactions/node_en
Finland	Y	Fullbright (as a part of general programme); https://www.fulbright.fi/en
Germany	N	
Netherlands	Y	European Topic Centre on Inland, Coastal and Marine waters; https://icm.eionet.europa.eu/
Norway	Y	EEA and Norway Grants (EOS-midlene); www.forskningsradet.no/en/EEA_and_Norway_Grants/1253987573811; Fish for Development and civil society 2018-022; www.norad.no/en/front/funding/fish-for-development-and-civil-society-2018-2022/; Fullbright scholarship; www.fullbright.no
Poland	Y	Fullbright scholarships; EEA and Norway Grants
Russian Fed.	N	
Sweden	Y	
UK	Y	Commonwealth Marine Economies Programme: www.gov.uk/guidance/commonwealth-marine-economies-programme)

➔ ***Most respondents (8 countries from 11) report to have bilateral scientific training schemes***

Table 9. Q. 60: Does your country take part in regional/international support/training programmes, such as POGO, SCOR, OT (Ocean Teacher), Regional Network of Training and Research Centers (RTRC), ICES, PICES, IOC to increase scientific support and training in particular ocean science related capacities?

country	Y/N	Training Programme
Belgium	Y	• Ocean Teacher Global Academy; https://classroom.oceanteacher.org • IOC Capacity Development WG; www.ioc-cd.org
Denmark	Y	ICES; www.ices.dk/Pages/default.aspx
Finland	N	
France	Y	
Germany	Y	• POGO; www.ocean-partners.org/training-education • SCOR; https://scor-int.org/work/capacity/ • IOC; www.ioc-cd.org/index.php?option=com_oe&task=eventCalendar&start=2018-07-01&end=2018-10-31&headGroupID=47 • ICES; www.ices.dk/news-and-events/Training/Pages/default.aspx • IOI - International Ocean Institute; www.ioinst.org/training/
Netherlands	Y	• POGO;www.ocean-partners.org/members • ICES; www.ices.dk • IOC-UNESCO; www.ioc-unesco.org
Norway	Y	
Poland	Y	IOC; http://ioc.unesco.org
Russian Fed.	Y	
Sweden	Y	
UK	Y	• POGO; www.ocean-partners.org/training-education • SCOR; https://scor-int.org/work/capacity/IOC - Sea Level Monitoring and training; www.psmsl.org/ • IOC - Tsunami training • IOC Capacity Development WG; www.ioc-cd.org

➔ ***Most respondents (10 from 11) report to participate in regional/international training programmes: SCOR, POGO, OTGA (IOC) and ICES are most mentioned***

3.2.2. IOC Capacity Development surveys

The IOC CD surveys (see section 2.1.) are a tool to support the IOC Group of Experts on Capacity Development in assisting the global and regional programmes with the implementation of capacity development (CD) needs assessments, the development of related work plans, mobilisation of resources, and provide advice on relevant methods and tools to deliver CD**.** The IOC CD needs assessment survey will be repeated every two years (2018, 2020, 2022). The results of the 2020 survey are published online (April 2021) 2020 Survey Results**.**

As is the case for GOSR2020 (see above), the quality of the analysis depends on the completeness and quality in the answers submitted by IOC member states. Often these responses are coordinated at national level by the IOC National contacts (NCP) or the IOC focal points (NFP) for capacity development. Unfortunately, the CD-survey was completed by only 4 countries from the Baltic and North Sea regions (Estonia, Finland, France, and Germany). Considering the restricted number of (partial) responses from countries bordering the Baltic and North Sea, a quantitative analysis of results is not relevant. Still, a number of observations and suggestions are included in the present report in view of recommendations towards future actions and strengthening synergies between initiatives for HCSD needs assessment (see below).

- There is a considerable overlap in focus/questions between GOSR2020 and CD survey 2020 (e.g. questions 2.A.6-2.A.11 (see Annex I) are also focus of GOSR2020. On the other hand, questions Q2.19 and 20 *"Does your country or institution have a national ocean science capacity development strategy? Q2.20: If yes, please specify*", as well as Q2.21 and Q2. 22: "*Has your country carried out an ocean science capacity needs assessment? Q2.22: If yes, please specify*" are relevant for both GOSR and CD surveys, however only included in the latter. This is also the case for the subset questions 2.A.12-2.A.16 take stock of the (potential) interaction between higher education and the private sector, and the involvement of HEI expertise (for research, monitoring, management) in the private sector;

- From a perspective of increasing coherence and improving response rates, it would be useful to consider alignment and synergies between both surveys in the (near) future.
- The specific formulation of the questions leave room for interpretation, which underlines the need for the use of standard vocabulary and makes it challenging to compare responses and conduct analysis in a regional context.

For the purpose of the current report, the response to Q2.19-Q2.22 are included as relevant and complementary input from the member countries, to GOSR2020 (see above).

Does your country or institution have a national ocean science capacity development strategy?
Estonia; Germany: No
Finland: Yes; National strategy for marine sciences in Finland
France: Yes; IRD (Institute for Research and Development) main mission is on capacity building. In addition, there are funding mechanism to support to virtual international (bilateral) laboratories in marine science (e.g. IRL-International Research Laboratory at CNRS, LMI- Laboratoire Mixte International at IRD). Financial support for individual scientists to expatriate to developing countries for periods ranging from a few months to years.

Has your country carried out an ocean science capacity needs assessment?
Estonia; Finland: No
France; Germany: Do not know

For now, the CD-survey and GOSR2020 analysis are the **best available systemic approach for assessment of capacity development needs in marine R&I** and can serve as a broad guidance. It is important to note again, that these tools are designed as dynamic instruments that can be further developed in co-design (e.g. by contacting the IOC NFP/NCPs) and that IOC-UNESCO is working to align synergies for both tools. (https://surveys.ioc-cd.org/index.php/2020-survey/ioc-focal-points/)

4. Strategy for Human Capacity and Skills Development in the Baltic and North Sea

The BANOS Human Capacity Development Strategy focuses on different aspects of human capacity building and skills development (HCSD), including cross/trans-disciplinarity, transferable skills, internationalisation, industry collaboration, continuous professional development and life-long learning. It aims for a long-term strategy to ensure appropriate academic and soft skills for the next generation of marine scientists. The strategy builds on existing experiences at global and EU level (offer), and needs assessments (demand) at national and sea basin scale. It explores innovative approaches in training and education (MOOCs, webinars, internships, e-learning, activity-based-training, summer schools…). It aims at training and skills development in areas ranging from knowledge transfer, open science, open data and research data management practices (FAIR data) to the inclusion of citizen science in research. The Strategy aligns with other tasks of BANOS CSA and specific HCSD needs as identified through the BANOS SRIA.

4.1. Stock take: Strategic Partner Organisations

Collecting information

In preparation of interviews/exchange of information with key people from the partner organisations and strategic partners, a desktop study was conducted, following a simple template and questionnaire. **In total, some 66 organisations and/or capacity development initiatives were screened and/or consulted.** The findings are included as annex report, in narrative. A synthesis is included in the present BANOS CSA Deliverable 4.4. 'Human Capacity Building and Skills Development Strategy'.

- **Sixteen (16) BANOS strategic partners** were consulted on their CD activities and approaches (including OSPAR, HELCOM, ICES, JPI-Oceans, JPI-Climate, EuroMarine, European Marine Board and IOC-UNESCO) – **section 1**
- **Targeted in-depth interviews** were conducted with key resources (JPI-Oceans secretariat **(4),** EuroMarine **(16),** European Marine Board secretariat (21), MATES project)- **sections 2, 3 and 4**

- In-depth research on secondary sources **(21)** was conducted on the **EMB publication 'Training the 21st Century Marine Professional' – section 2**
- **Additional sources (9)** from the targeted search through desktop study are included **- section 5**

Questions/template

- Is capacity development/building part of the (published) activities of the partner institution, as communicated through their website and publications?
- If so
  - What is the focal domain and target group?
  - Who are the strategic partners with regard to HCSD?
  - Are these HCSD activities grounded in their SRIA/implementation plan…?
  - Does the partner organisation aim for certain (measurable) objectives, and are these monitored and evaluated?
- If not
  - Are there plans to implement any HCSD initiatives in the future?
- Any other recommendations, sources…

Synthesis of findings

The desktop study involving over 60 organisations and capacity development initiatives yielded a rich collection of information as learning experiences. There is ample experience and a broad range and diversity of HCSD/training resources available within the consortium and direct network of (strategic) partners of the BANOS member organisations and countries. The rich information obtained from the interviews and desktop study (2019-2020) is collected in the overview, available as Annex. An overview of the experiences and initiatives among strategic partners (16) is included in the table below.

Table 10. Overview of the experiences and initiatives in Capacity Development HCSD among strategic partners (16)*

Partner Organisation	Topic-Type-Description	Embedded in strategy?
BONUS	BONUS Young Scientist Club: organised training sessions and hosted training material online, targets young scientist community in the Baltic Sea region, i.e. early career researchers *(see Best Practices).*	BONUS Programme
ICES	• The ICES Training Programme: targets participants of the scientific and advisory process (high-profile scientists and instructors), with focus quality assurance in the advisory process • The ICES Annual Science Conference targets marine scientists. • ICES Annual Report 2018: ICES pledges to enhance marine science training and capacity building in support of SDG14	Science Plan Priority 31 promoting the "establishment of guidelines and quality standards for […] training and capacity building opportunities for monitoring activities".
HELCOM	Short training sessions on data management, taxonomic identification and pollutions response	HELCOM's 2013 Monitoring and Assessment Strategy; Data and Information Strategy.
Barcelona Convention	The 'Horizon2020 Initiative', led by the Union for the Mediterranean Mediterranean Action plan (MAP/UNEP) focuses on reduction of pollution in the Mediterranean pollution in the framework of the Barcelona Convention, capacity building is one of its main topics.	CD activities are implemented since 2016 as the SWIM-H2020 Support Mechanism.
BlackSea Connect	Capacity development focusing on pollution, alien species, fisheries management	Black Sea Connect SRIA
CPMR	CPMR (co)organises and supports summer schools and training sessions. Contributes to the EU Commission's Expert Group on maritime skills, the Blueprint initiative, and the Blue Biotechnology Master for a Blue Career (BBMBC) project, one of the 6 EMFF-funded 'blue careers' projects.	
European Marine Board	• EMB is involved in number of projects with strong CD component (SEAS-ERA WP5, SOPHIE…). • EurOCEAN conferences	Future Science Brief on training the 21st century marine professional (2018)

	• EU Parliament event on "Young Talent and the Blue Economy - Towards a fit-for-purpose training for marine graduates" in 2018. • EMB - University Consortium Panel, a forum for its members that are involved in higher education, to support graduate and PhD student training. • EMB recommendations on capacity building in Future Science Brief	
EuroMarine	• Capacity building for young scientists is a key priority. • EuroMarine member organisations set up internal courses and advertise internal/external CD events via Marine Training Platform. • EuroMarine (co-)finances calls through the Young Scientist Individual Fellowship Programme, providing early career researchers with funds to attend training courses. The EuroMarine Young Scientist Working Group (YSWG)- now OYSTER – focus on CD of young scientists, launched a mentorship platform in support of Early Career Scientists.	EuroMarine 'Working Group on Enhancement of Human resources: a focus on fisheries, aquaculture, and seafood processing' (EHUSEA) developed a 'Strategic Agenda on Enhancement of Human Resources to support Blue Growth sectors' (EHUSEA Strategic Agenda 2019). SA identifies training needs in fisheries, aquaculture and seafood, existing HCD tools.
JPI Oceans	Human capacity building is one of the three cross-cutting issues identified by JPI Oceans, focusing on five lines of human capacity building activities: 1. Training and education 2. Jointly recognised educational modules 3. Long-term plan for human resources development 4. Develop science-policy capacities 5. Launch a Knowledge and Innovation Community (KIC)[7]	JPI Oceans SRIA 2021. HCSD builds further on deliverables of the CSA Oceans: D6.1 "Mapping and preliminary analysis of infrastructures, observation -data and human capacity building" and D6.2 "Needs and gaps in infrastructure and human capacity building to feed the SRIA".
Belmont Forum	Implements e-I&DM through four Action Themes, which includes Action Theme 4: Capacity Building & Human Dimensions: webinars, workshops, Data Skills Curricula Framework, Skills Gap Analysis. The focus of e-I&DM is the development of data skills (management, access and reuse of data), aiming for scientific researchers globally and with emphasis on environmental change research. The e-I&DM Community pursues collaborations with the ESIP Data Management Training Clearinghouse, the FAIR Data Initiative and other partners to disseminate and promote their Data Skills Curricula Framework.	Y 2015 Belmont Forum "e-Infrastructures and Data Management e-I&DM Community Strategy and Implementation Plan
JPI Climate	• JPI Climate's programme SINCERE (WP4) targets African climate change researchers and their organisations, with the objective to increase the capacity of African climate research. • JPI Climate's ERA4CS initiative (ERA-NET Cofund) centres on HCSD hosting summer schools (2108) with focus on the interdisciplinary research and science-practice interface of climate services and targets early career researchers of JPI Climate member states. • ERA4CS webinars (2017) fill knowledge and information gaps related to climate services and around specific topics, target researchers and practitioners.	The JPI Climate SRIA 2016-2025 focuses on HCD and aims for enhanced alignment of research between participating countries. The SRIA explores the role of capacity building in enabling societal transformation.
EurOcean	EurOcean focuses on marine knowledge transfer through supporting databases 'Marine Knowledge Gate (KG)' and 'Marine Research Infrastructures Database (RID)'; used by the European marine science and technology community at large. Organises seminars and summer schools on marine knowledge transfer, e.g. "How to Communicate Marine Sciences and Technology? Bridging European Marine Information" and "Supporting Marine Research Knowledge Exchange for Blue Growth".	

[7] "The European Institute of Innovation and Technology (EIT) and its Knowledge and Innovation Communities (KIC) bring together major players from higher education, research and business to stimulate innovation via the full integration of the Knowledge Triangle. […] There are currently no plans for a KIC devoted specifically to the blue economy. In the context of the preparation of the Strategic Innovation Agenda and amended legal base of the EIT for the period beyond 2020 the Commission will examine whether the creation of a specific KIC for the blue economy after 2020 could be of value." (European Commission COM(2014) 254 final/2)

Marine Institute	Explorers Education Programme: provides marine classroom resources, teachers training and Continuing Professional Development courses. The 'Maritime websites' provide maritime classroom resources and information on maritime careers. The Irish Seafarers Education Assistance Scheme (ISEAS) Programme secures training places of cadets as maritime professionals at shipping companies. The MI infrastructure (incl research vessels) is available for training purposes, e.g. within the SMART and Eurofleets programmes.	Marine Institute 2018-2022 Strategic Plan: strategic focus areas supported by strategic enablers. "Engagement and Education" strategic initiative "New Generation of Ocean Professionals", focuses on HCB.
IOC-UNESCO	See section 2: IOC CD strategy and Ocean teacher Global Academy	Y
**HCSD is not part of the remit of the OSPAR secretariat and the ERRIN.*		

Key resources (publications) in HCSD identified by strategic partners

Through the interviews (and desktop study where explicitly identified) strategic partners identified additional relevant resources for articulation, and to serve as context for the future BANOS HCSD strategic framework:

- **European Marine Board "Training the 21st Century Marine Professional:** A new vision for marine graduate education and training programmes in Europe." Training the 21st Century Marine Professional: A new vision for marine graduate education and training programmes in Europe. Vincx, M., Antia, A., Deprez, T., Fiksen, Ø., Koski, M., Mackenzie, B., McGrane, P., O'Carroll, C., Olsen, J., Menezes Pinheiro, L., Ribera d'Alcalà, M., Roullet, G 2018
- **Skills Forecast: key EU trends to 2030**, CEDEFOP 2018
- **CEDEFOP publications** on Skills Panorama; documents are addressing different sectors, containing interesting presentations on general trends.
- **Changing Nature & role of VET in Europe** Volume 3: the responsiveness of European VET systems to external change (1995-2015)- **part 2** and **part 3,** CEDEFOP 2018
- **Moving between jobs:** an analysis of occupation distances and skills needs. Nagui Bechichii, Robert Grundkei, Stéphanie Jameti and Mariagrazia Squicciarinii 2018
- **New skills Agenda for Europe.** Working together to strengthen human capital, employability and competitiveness, European Commission 2016
- Repeal of Recommend European Parliament and of the Council of 23 April 2008 on the establishment of the **European Qualifications Framework for lifelong learning**, European Commission Strasbourg 2016
- On a new set of medium-termed deliverables in the field of VET for the period 2015-2020, as a result of the review of short-term deliverables defined in **2010 Bruges Communiqué**, European Commission 2015
- EQAVET Framework in VET: Quality Assuring Work-based Learning, EQAVET 2012
- **Lifelong learning, mobility and new training programs in the blue economy**: Best practices and user stories – Study Directorate-General for Maritime Affairs and Fisheries (European Commission) 2018
- **Bridging education and business in the blue economy Best practices and user stories** – Study Directorate-General for Maritime Affairs and Fisheries (European Commission) 2018
- **Ocean literacy Best practices and user stories** – Study Directorate-General for Maritime Affairs and Fisheries (European Commission) 2018
- **State of Policies and Strategies for Training, Education and Knowledge development**, Indra Vonck 2014
- **Blue Skills Expert Group** (Andreea Strachinescu, DG MARE). Public information on this group meetings at: https://webgate.ec.europa.eu/maritimeforum/en/frontpage/291. The group has compiled Best practices related to Life Long Learning, Bridging Education and Business at the Blue economy and Ocean Literacy.

4.2. Discussion

A number of general elements are drawn from the desktop study, the literature review and the interviews with strategic partners and expert networks. These are included in the section below, and provide context as conclusions towards the recommendations. The purpose is to draw attention to both challenges and opportunities, and enhance the quality and relevance of training in sectors in the traditional and emerging Blue Economy sectors and beyond, to address grand societal challenges.

- **Marine HCSD: a fragmented landscape**

The desktop study, literature review and the interviews have put in evidence the broad and fragmented landscape of HCSD initiatives, networks, responsibilities, roles, resources and funding. Nevertheless, HCSD is often treated as a separate, stand-alone, or not fully embedded or integrated component of broader strategic marine R&I agendas. Hence this bottleneck often trickles down in programmes, projects and actions. The recent initiatives at EU programme level (Horizon Europe- dissemination, outreach and knowledge transfer; Blue Growth Strategy and Blue Careers, see above) are taking action for a more integrated approach and intervention logics. Also, in the context of the SDGs and in particular the UN Ocean Decade, the global initiatives to map ocean research capacities and assessments of capacity development needs, are taking an increasingly coherent and systemic approach. Collaboration in quadruple-helix is fundamental to achieve synergies and impact.

- **Marine Sciences Graduate Education: an outdated model?**

Generally taken, PhD programmes are academic degrees focusing on research and designed to train academic researchers with focus on excellence, creative thinking and production of new knowledge. Academic institutions and students perceive a PhD as a preparation for an academic career. Postdoctoral projects also provide a platform for trial and learning process. However, only 10-15% of graduated PhDs will ultimately be able to achieve an academic or similar research appointment. This means that 85-90% of PhD graduates explore job opportunities outside of academia. This has put in evidence that the existing modes of academic/discipline-based training are not meeting the needs of workplaces outside of the academic environment (Vincx et al 2018; DTU Aqua and IMAREST Case Studies). According to EMB panel of experts, the Masters and PhD programmes in the marine sciences in Europe are largely based on outdated models that need to be redefined in view of variable-tracks (see MASTS and Annex III) that are tailored to the job market, often in the marine and maritime private sectors. This is mostly the case for transferable skills and high-end technical expertise, and is best tackled by early collaborations with the private sector to offer options for on the job training (see best practices).

- **Marine graduate education: also about transferable skills**

There is a gap between the industry needs and education, however there is also a gap between student expectations and education. The education system still focuses on teaching rather than learning, and is currently not adapted to self-training. More effort is needed to accommodate life-long learning and multidisciplinary approaches, and an increased focus is needed on transferable skills. Although over 50% of the PhD programmes surveyed by the EMB include some form of transferable skills training, the general conclusion is that this occurs far too late in the educational process (Vincx et al 2018). According to this EMB expert panel, transferable skills training should take place at Masters or Bachelor-levels. Industry, academia and policy need to communicate better, because conditions are dynamic; adaptation is key; better combinations of on-site and in-class training are needed, and the role of the industry and private companies (e.g. in providing internship opportunities) is crucial to gain experience in updated practical knowledge and skills. Students need a better view on the full possible career path, so we need to raise awareness of existing options in education. When they are better informed, they will be able to adapt to changes.

- **Marine graduate education: jobs for the Blue Economy agenda**

The mismatch between the knowledge and competences acquired throughout the educational path and those required on the job market in the maritime industries across Europe, is put in evidence through different studies and mapping exercises. The EMB conducted a survey among providers of training in HEI degrees. Most of the graduate programmes were found not to offer topics related to the key areas of the EU blue Growth agenda (Vincx et al. 2018). To address this mismatch, the European Commission launched the Blue Economy Business and Science Forum[8] at the European Maritime Day in 2015 (Greece), with the aim to bring together different actors e.g. business, industry, researchers and investors to develop a Knowledge Alliance (KA) and Marine Sector Skills Alliance(SSA) (DG MARE). KA are structured partnerships bringing together relevant actors from higher education and business to stimulate innovation in and through higher education (under ERASMUS programme). SSAs foster dialogue between industrial sectors and bodies

[8] http://europa.eu/rapid/press-release_IP-14-536_en.htm

involved in designing, accrediting, implementing and evaluating education and training systems. The SSAs aim to design and deliver joint curricula and methods which provide learners with the skills required by the labour market.

In 2016, DGMARE launched a call for proposal on 'Blue Careers in Europe' under the European Maritime & Fishery Fund (EMFF) (C(2015) 8729 annex) to catalyse enhanced cooperation between education and maritime business (see also section 3.1.). This is a continued effort and work in progress, as the maritime sectors are dynamic with emergent sectors.

The European Institute of Innovation and Technology (EIT) and its Knowledge and Innovation Communities (KIC) bring together partners from higher education, research and business to stimulate innovation through integration of the Knowledge Triangle. KICs have been set up on climate change, sustainable energy and ICT-related challenges, innovation for healthy living and active ageing, raw materials, food for the future, added value manufacturing and urban mobility. There is currently no KIC devoted specifically to the blue economy.

The EU has developed a number of tools that increase recognition and transparency of skills, competences and qualifications such as the European Qualifications Framework (EQF), the European Skills, Competences, qualifications and Occupations (ESCO) portal, etc. These quality assurance and credit systems will need to take the requirements of the blue economy into account.

- **Marine graduate training: innovation and ocean solutions**

The Blue Growth strategy underlined the need for skilled and suitably qualified graduates in marine, maritime and engineering sciences in order to ensure innovation. Lessons can be drawn from the technology field, where the need to develop "data scientists" less than 10 years ago has led to this becoming one of the fastest growing employment areas. The Blue Growth communication put in evidence that mechanisms for transferring research results into commercial applications are largely ineffective or insufficient, and pointed towards the need for synergies, better alignment and increased collaboration between public and private sectors on innovation.

Opportunities for increased collaboration between HEIs and the private sector are multiple: through matched funding, seeking synergies between funding mechanisms and (strategic) objectives, and by aligning strategies e.g. in a context of regional implementation. Collaboration and co-creation is increasingly leading to the implementation of Innovation Hubs, Innovation Labs, Science Parks etc. European Marine Research infrastructures can play this catalyst role, as open labs for innovation and creation of new ideas.

- **Innovative Marine HCSD and Training**

At the EU-policy level three major pillars for innovative graduate training have been put forward (European Universities Association, 2005[9]):

1. Research performance with following principles: Research Excellence, Quality Assurance, Interdisciplinary Research Options and International Networking;
2. Attractiveness of pursuing an advanced degree as 'researcher' by creating an appealing and professional institutional environment;
3. Interface with the labour market through exposure to industry and transferable skills training.

The principles of cross-disciplinarity, transferable skills, internationalisation, industry collaboration, life-long learning and recruitment and branding are also key factors for successful graduate programmes.

The European marine science community has recognised the need for "innovation in the provision of undergraduate and postgraduate training and enhancing skill sets and career pathways for marine professionals" (Rome Declaration[10]). The Declaration also stressed the need for education and training to encompass and foster cross-disciplinarity.

Improved linkages between industry, marine management agencies and higher education institutions offer the opportunity for organizing innovative approaches such as Internships in companies, industrial placements and guest lectures from industry and policy experts in training curricula. International Mobility and Networking and Collaboration

[9] Doctoral Programmes for the European Knowledge Society. Report on the EUA Doctoral Programmes Project, 2004-2005. Available at: http://www.eua.be/eua/jsp/en/upload/Doctoral_Programmes_Project_Report.1129278878120.pdf

[10] http://eurocean2014.eu/declaration/

are crucial enabling mechanisms. Initiatives like the marine training portal can help in joining forces on training and avoid duplication.

The EuroMarine initiative develops a broad-scale marine network of excellence across academic and research institutions in Europe. A particular focus is on graduate training, with support for summer schools and international exchanges across a range of marine science fields and topics. Innovative training also requires a systemic approach for recognition and rewarding in terms of career incentives for academics and teachers that engage in innovative international training collaborations and other alternative contributions to civil society. This is a societal and (scientific) cultural issue that needs to be considered at multiple institutional levels, with an opportunity for leadership at the European level, and in the marine domain. Lessons can be learnt from other regions or institutions (e.g. DORA Declaration; Commonwealth Scientific and Industrial Research Organisation (CSIRO)80-Australia: an impact oriented approach to judging the success of applied scientific efforts in the marine realm).

- **Marine HCSD: a new generation of sustainability scientists for the ocean:**

Addressing challenges of sustainable development requires innovative pedagogical methods to train the next generation of scientists in applying a systematic and holistic approach in understanding human–environment interactions. The disciplines of human sciences are traditionally less represented in marine sciences. The European Academies' Science Advisory Council (Thiede et al. 2016) and European Marine Board (Vincx et al. 2018; EMB Navigating the Future 2019) recommend to develop sustainability science as scientific approach, in parallel to dedicated training in traditional disciplinary areas to include skills such as engagement and science communication. The Erasmus programme can support these unique training prospects, with focus on postgraduate students.

- **Marine HCSD: a multi-stakeholder environment and a broad menu of tools and approaches**

The desktop study and interviews collected the broad scale or 'category/Type' of tools and approaches implemented by the BANOS (strategic) partners and their networks (see Table 11, column 1), with an indication of the organiser 'Stakeholder Type' (Table 11: row 1): Academia and HEI; Research Performing institute; Policy & governmental stakeholder; and/or in co-design). The values in the fields refer to the number of initiatives screened and included as demonstrator. The numbers therefore do not contain any value judgments or entail qualifying values, they are a simple quantitative expression of the number of initiatives identified and screened during the desktop study, most upon suggestion by interviewees. The Table is intended as a first resource and provides a link to first-hand experiences for each particular tool or approach. The full details and links are provided in the Annex III. Although the approach did not allow for a time-series analysis to assess an increase in approaches developed in co-design, it is worth noting that examples of co-design development/implementation exists for nearly all types of tools. The co-design make up the largest part (37%) of the 'best practice' examples put forward.

Table 11. Overview of Categories of HEI - Training and Education tools and approaches, as screened in the desktop study and interviews with strategic partners. The values in the field refer to the number (quantity) of examples screened. The full list of initiatives and references is included in Annex III. (X) in the table refer to tools for which no example was included in the screening/Annex menu table.

CATEGORY/TYPE	Academia and HEI	Science & RPO	Policy & govermt	Co-design	Private sector/ business	
DESCRIPTION	organised solely by or through HEIs and exclusively for students/PhD/Postdoc	organised by scientific institutions (possibly in collaboration with HEIs) and/or aimed at a scientific audience	organised by policy-informing bodies and/or aimed at scientists, policy makers, professionals	co-designed by research and industry actors	organised by a company and aimed at (potential) workforce	*Number of initiatives screened*
Short training courses incl. workshops, seminars, excursions		9	7	9	3	*28*
E-learning and blended learning - webinars, slides, courses, moodles, MOOCs, distance learning, VREs	3	11	2	11		*27*
Advice – studies& recommendations on HCSD	4	6	10	6	1	*27*
Infrastructure available for training - shiptime, access to marine stations and labs, computational resources	1	9		5		*15*
Accredited post-secondary degrees - HEI and vocational	4			9	1	*14*
Doctoral degrees and training	5	5		2		*12*
CoE, network, funding scheme - with focus on training or establishing a formal qualification framework		1	1	10		*12*
Summer Schools	1	5	3	2		*11*
Mobility support - for students, professionals, lecturers	3	2	1	4		*10*
Internships (includes companies)		1		4	x	*5*
Conferences - and symposia, with HCSD as objective		1	3	1		*5*
Classroom visits		2	1			*3*
Young Scientists Clubs; Youth Club;		2	1			*3*
Train the trainers, Training design, training materials; delivery of training courses	x	x				
Hackathons		x		x	x	
Virtual reality Labs, Digital Twins				x	x	
Massive Online Open Course MOOC		x		x		
Number of initiatives screened in the present study	*21*	*54*	*29*	*63*	*5*	*172*

4.3. Best practices in global and EU context

The Global Initiatives implemented under **SCOR, POGO and IOC-Ocean Teacher** are provided as multi-lateral/multinational examples (see section 2.1.-2.3.) of training and capacity development accessible for a broad target group of ocean professionals (academic and HEI).

Additional examples of 'best practice' at EU and national/local level are included below, to illustrate the diversity of approaches as collected in Table 11 and Annex III.

1. **Service Platform - Marine Training**

'MarineTraining.eu' started as a service of the European Marine Biological Resource Centre (EMBRC) and it is hosted at Ghent University (UGent). It is a service platform dedicated to Marine education and training. EMBRC-ERIC is a pan-European 'research infrastructure' for marine biology and ecology research, addressing fundamental questions regarding the health of oceanic ecosystems in a changing environment. Training the next generation as well as re-training the current generation of 'blue workers' belongs to the key goals of the infrastructure. It focuses on cross-disciplinarity, transferable skills, internationalisation, industry collaboration, and lifelong learning. The aim is to boost marine science education and human potential to fully integrate higher education, research and industry.

MarineTraining.eu provides an overview of and allows free discovery of Marine and Maritime Master programmes, expanded with short course offers around the world. This Marine Training platform provides matchmaking services to Trainees in search of Marine and Maritime training initiatives, Trainers in search of assistance for organising European Marine and Maritime training initiatives, and Stakeholders in search of insights into European Marine and Maritime training initiatives and globally as MarineTraining.org.

The number and types of Trainings included are (status February 2021):

- Short trainings: courses, workshops , webinars (399): of which On-site (327), Online (46), Blended (26)
- Training Programmes (2858) with Programme type categories:
  - Bachelor (ISCED 2011 level 6) (1244)
  - Master (ISCED 2011 level 7) (1182)
  - PhD (ISCED 2011 level 8) (374)
  - Short-cycle tertiary education (ISCED 2011 level 5) (58)

2. **The International Master of Science in Marine Biological Resources (IMBRSea)**

IMBRSea is a joint Master program in the field of marine sciences, supported by the European Marine Biological Resource Centre (EMBRC). IMBRSea focuses on students training in areas of demand by the blue bio-economy and research on the sustainable use of marine biological resources. Partners of this ERASMUS+ programme are Ghent University - UGent (BE) (coordinator); University of Sorbonne - SU (FR); University of Bergen - UiB (NO); University of Western Brittany - UBO (FR); University of Gothenburg - UGOT (SE), and University of Algarve - UAlg (PT); University of Oviedo - UniOvi (ES); Galway-Mayo Institute of Technology - GMIT (IE); University of the Basque Country - UPV/EHU (ES); Polytechnic University of Marche - Univpm (IT).

3. **Maritime Alliance for the Blue Economy - Marine Technology Skilling Strategy (MATES).**

MATES (ERASMUS+) objective is to develop a skills strategy that addresses the main drivers of change to the maritime industry, in particular shipbuilding and offshore renewable energy. Both sectors are strongly linked and require new capacities to succeed in an increasingly digital, green and knowledge driven economy. MATES dissemination and outreach plan aims to increase the attractiveness of careers in the shipbuilding and offshore renewable energy sectors, while also ensuring future adoption of the strategy. MATES 11 pilot case studies test the MATES concepts on digital skills, green skills, mobility, innovation management, curricula development and ocean literacy. MATES widens the approach by articulating formal training in HEI and with the industry perspective.

4. **Support for Smart Specialisation Strategies - The Right Skills for the Right Future (RIGHT)**

RIGHT (Interreg North Sea Region) aims to enhance regional innovation support capacity to increase long-term

innovation levels and support smart specialisation strategies (S3)**.** Defining and solving the skills gap in relation to regions' growth potential through smart specialisation is a new approach for the (7) regional partners. To achieve this, RIGHT concentrates its efforts on developing the skills of the workforce relevant for SMEs in the participating regions within the energy and blue sectors. It is a collaborative effort to define:

- existing and potential regional growth sectors and sub-sectors (blue economy and energy);
- skills gaps to unlock innovation capacity by testing new models to overcome skills barriers.

The project designs and tests tailored educational and training programmes and initiatives to bridge the skills gap in a fast-changing skills environment in emerging and growth sectors. The results will be capitalised by the partner regions to give long-term impact as a response in the context of fast changing skills demands. *Right gathers 14 partners including regional partners, knowledge/R&D partners and industrial development bodies. Partners are: in NORWAY: Vestland County Council (LB), Alver Municipality, GCE Ocean Technology, NCE Seafood Innovation Cluster; THE NETHERLANDS: The Province of Groningen, Hanze University of Applied Sciences; UK: Fife Council (Scotland); SWEDEN: Skåne Region, Industrial Development Center South (IUC Syd); BELGIUM: The Province of Antwerp, Ghent University; GERMANY: The Johann Daniel Lawaetz Institute, Hamburg University of Applied Sciences (HAW); DENMARK: Vordingborg Erhverv.*

5. BONUS Young Scientist Club

Launched in 2009 as an investment in young scientists' community in the Baltic Sea region, the BONUS Young Scientist Club (YSC) promoted the creation of networks of leading Baltic Sea scientists across disciplines in the early stages of their careers and set foundation for networking and collaborations in the future. The BONUS Young Scientist Club sponsored training sessions organised most often during the Baltic Sea Science Congresses (BSSC) but also as stand-alone training sessions enhanced in particular young scientists' transferable skills' development. The following Club training sessions were convened:

- *YSC Stockholm (BSSC 2019) introducing the COMPASS message box as a tool in improving science outreach work*
- *YSC Rostock (BSSC 2017) on 'Turbo-charge your writing and communicate the impact of your research!'*
- *YSC Riga (ICES ASC 2016) joint BONUS and ICES workshop on getting published*
- *BONUS & PE2020 training 'Gaining insights into social media and blogging' (Helsinki University and online 2016) on best practices for different social media channels, and the secrets of effective and inspiring blogging with a 'blog clinic exercise'*
- *YSC Riga (BSSC 2015) 'Seven secrets of extremely successful researchers'*
- *YSC Klaipedia (BSSC 2013) public engagement*
- *YSC St Petersburg (BSSC 2011) hosted by the Russian State Hydro-meteorological University's young scientists*
- *YSC Vilnius (2010) - scientific game evening*
- *YSC Helsinki (2009) founding event*

Also an online blogging platform created by BONUS provided early career researchers (PhDs and first-term PostDocs) an opportunity to practice writing skills and share their experiences on research, fieldwork, life/work balance, new collaboration, current scientific trends, tips for applying for funds etc. and brought young scientists across different projects together to share knowledge and experiences beyond the actual research itself .

6. Postgraduate Certificate Marine Alliance for Science and Technology for Scotland - MASTS PG Cert

The training framework of the 'Postgraduate Certificate in Researcher Professional Development for Marine Science and Technology (MASTS PG Cert)' offers flexible training opportunities through a tailored programme specifically oriented towards marine science students. MASTS PG Cert combines academic graduate degrees with training and skills that are relevant to future employers, by allowing choices during the doctoral studentship, by developing a wide range of skills beyond the in-depth knowledge and understanding of the selected research topic. These skills form an important part of professional development. MASTS also promotes students in enhancing their professional skills and employability by planning and undertaking specific training, or engaging in conferences, cruises, teaching, internships or voluntary work. Students can design a bespoke training programme that supports their research, career and personal goals. On completion of the PhD and the PG Cert students will acquire the expertise, skills and knowledge in their specific discipline of choice, as well as broad and deep transferable skill set. In the MASTS learning environment, these transferable skills may include:

- Work in multi-disciplinary and inter-disciplinarily teams, create collaborations and synergies between marine sciences and other academic areas and sectors

- Work at sector interfaces, including specialised field of marine science research, and others such as environment, policy, businesses, industry, economic, social, legal and political systems, and co-develop research with stakeholders
- Deploy effective communication skills that promote convergence of understanding to drive innovation and deliver progress to address marine related societal challenges
- Understand research translation, knowledge transfer and application of marine research, including links to end users and creation of economic and social benefit
- Be aware of specific social and ethical issues surrounding your discipline and marine science and technology more generally

7. European Open Science Cloud - EOSC- skills and competences

The European Open Science Cloud (EOSC) promotes digital skills for FAIR and open science and underlines the need to take a coherent approach in a (sometimes fragmented) European HCSD landscape. The EOSC formed a Skills and Training Working Group in 2020 to develop a skills and competence framework (entitled FAIR4S). The WG aims to coordinate and align relevant digital skills curricula and training frameworks by generating a consensus on a core European higher education curriculum to deliver FAIR and open science skills at university level and support the competence centres approach as a framework for increasing coordinated provision of aligned training to support FAIR and open science. The FAIR4S is designed for employers, learning providers and others to describe learning resources and training opportunities, and to produce job descriptions in areas relevant to EOSC. The FAIR4S framework and EOSC community promote the creation of a registry of learning resources and training opportunities, a coordinated approach among stakeholders in skills development to share learning and training resources in a FAIR way, and avoid duplication of efforts. Organisations or consortia engaged in skills development can adapt and apply FAIR4S, e.g. to offer disciplinary adaptations of the skill and role profiles.

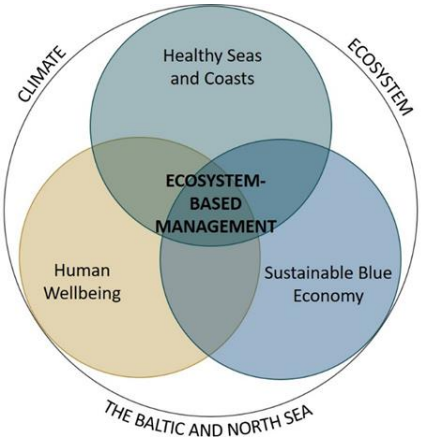
5. Outlines of the future BANOS Programme scope on HCSD

The future BANOS Programme scope on Human Capacity and Skills Development HCSD will articulate at three main levels:

1. Thematic/disciplines, as identified by the co-designed BANOS SRIA
2. Skills required in the context of research and Innovation Enabling Mechanisms
3. Transversal/Transferable and interpersonal skills

1. Thematic or Discipline-specific HCSD The overall framework of the BANOS SRIA consists of the three mutually interlinked strategic objectives, with an overarching aim to support and enable the ecosystem-based management in the BANOS region (Figure 5). In the co-design process of the SRIA, stakeholders prioritised 32 R&I themes under the three main objectives and these R&I themes will define the discipline-based content of HCSD actions in the future BANOS Programme.

The thematic or discipline-specific HCSD actions will be guided by the content, knowledge transfer and outreach and dissemination values of specific calls and their objectives. The HCSD actions will be defined in content by the SRIA specific calls, and implemented at project level, however they will follow generic project guidelines on HCSD that will be applicable at the programme level (see section Recommendations).



A. Healthy Seas and Coasts

B. Sustainable Blue Economy

C. Human Wellbeing

In addition, three attributes defining the scope of the future BANOS Programme are (i) relevance to ecosystem with biodiversity as its principal component, (ii) dependence on climate impact and (iii) geographic relevance to the Baltic Sea and the North Sea.

Figure 5: Three mutually interlinked BANOS strategic objectives, overarching aim and common attributes.

Table 12. Overview of BANOS SRIA Strategic Objectives, aims; specific objectives and linkages with broader policy frameworks. The R&I themes are 29 in total, and will define the discipline-based content of HCSD actions in the future BANOS Programme.

A. Healthy Seas and Coasts (4)	**B. Sustainable Blue Economy (2)**	**C. Human Wellbeing (3)**
To enhance the capabilities to protect the Baltic Sea and North Sea ecosystems while enabling more sustainable use of marine space and its resources.	To enable the sustainable development of the blue economy sector in the BANOS region aligned with the principles of the ecosystem approach to management.	To provide a new knowledge base and solutions that support human wellbeing and emotional connection to the sea, promote the understanding of the value of ecosystem services in management and decision making.
A.1: A Resilient Marine Ecosystem	B.1: Sustainable Resource Management of Marine Commons	C.1: Safe Food and Feed
A.2: Seamless Governance Linking Land, Coast and Sea	B.2: Sustainable, Smart and Circular Solutions for Blue Economy	C.2: Safe and Accessible Coast
A.3: Digital Ocean - Competent Ecosystem Modelling, Assessments and Forecasting		C.3: Understanding the Benefits of Ecosystem Goods and Services as Sources of Human Wellbeing
A.4: Efficient Techniques and Approaches for Environmental Monitoring and Assessment		
***13 R&I themes** – in support of implementation of HELCOM BSAP, OSPAR NEAES, the European Green Deal (EGD), MSFD, SDGs*	***8 R&I themes** in support of EGD, the Blue Growth Strategy and forthcoming new strategy for a sustainable blue economy, CFP, MSPD*	***8 R&I themes** in support of EGD, Blue Growth strategy, MSFD*

2. Skills required in the context of research and Innovation Impact Enablers

The BANOS SRIA draws the attention to the importance of research and innovation 'impact enablers'. These key enablers of impact are implemented to unlock added value at regional, European and global levels. Key impact enablers explicitly included in the SRIA were addressed through preparative tasks in the BANOS CSA. They include:

- Science Communication
- R&I impact monitoring
- Knowledge synthesis,
- Collaboration across R&I funding streams (and R&I infrastructures)
- Human capacity development
- Open science
- Open data
- Citizen science, and Ocean Literacy
- Open innovation
- R&I cooperation across the regional seas

The Skills required in support of R&I enabling mechanisms in the future BANOS Programme will be guided by the content, knowledge transfer and outreach and dissemination values of specific calls and their objectives. These HCSD actions will follow generic project guidelines (see section recommendations).

3. Transversal/Transferable or interpersonal skills (see section 1 and 3.1, and MASTS). Includes the development of skills and training on science impact enablers such as the implementation of Open Data, Open Access, Data Management Plans, Output Management Plans, Communication Plans, Open Innovation, and the inclusion of Citizen Science. The final reports from BANOS CSA tasks on these aspects are available from www.banoscasa.org

6. Recommendations

The recommendations included in this section were formulated based on interviews with a wide range of stakeholders and expert sources in the area of HCSD. They build on existing insights and recommendations from capacity development initiatives, notably those proposed by the European Marine Board, the European Science Cloud (EOSC), EASME, JPI Oceans and others (not exhaustive list below):

- **ERRIN**: 2013 EU LeaderSHIP 2020 Initiative. p.14 section 4.1
- European Marine Board: 2018 Future Science Brief 2: Training the 21st Century Marine Professional p. 28 key targets, p. 37 recommendations
- **CPMR** : https://www.bbmbc.eu/medias/uploads/a/1/45-bbmbc-final-recommandations-to-eu.pdf
- Recommendations for skills development to the EC based on the BBMBC project.
- **JPI Oceans**: http://www.jpi-oceans.eu/human-capacity-building-1; The 'support to implementation' section And 2014 CSA Oceans D6.2; 'chapter 6: New Skills for Human Capacities'
- **BLUEMED Initiative / BLUEMED CSA**; D3.7 Assessment on improving human resources for Blue careers (2018); p. 88-94, discussion of common HCSD practices, trends and recommendations for the Mediterranean.
- **European University Association**; Learning and Teaching Paper #7: Digital skills
- **League of European Research Universities**; 2014 Advice Paper on online learning at research-intensive universities p17-18; 2014 Advice Paper on good practice in doctoral training p29; 2019 Advice Paper on student entrepreneurship p20-21
- **Science Connect**; 2017 Career Tracking Survey of Doctorate Holders; 'Chapter 5: Discussion and Conclusions'
- **Eunomia**; Green Jobs in the Blue Economy – A Bottom-up Approach; p. 50 Recommendations
- **EASME**; 2016 EASME study supporting a possible network of maritime training academies and institutes in the Mediterranean Sea basin; Chapter 4: Conclusions and recommendations: a 'Passage Plan' p. 57; 'Conclusions and lessons learnt' sections pp. 30, 36, 42, 48, 54

The recommendations below will require further discussion within the consortium and partnership to select and prioritise the desired features of the future BANOS HCSD Strategy. Recommendations are formulated at different levels:

7.1. Broader policy level (global/EU/sea basin)
7.2. BANOS Programme level (generic/strategic)
7.3. Project or action level (focused/theme-specific)

6.1. Recommendation at the broader policy level (global/EU/Sea Basin)

The first set of recommendations aim at the broader policy level (global/EU/sea basin). These can be translated into action and taken forward by international member-based organisations that take up advisory roles (European Marine Board, EuroMarine, EurOCEAN, ERVO…), by national focal points and funding agencies, and networks of Universities and HEI.

- **Take informed policy decisions - Target real needs**
  - Support and contribute to the **design and development of policy supporting instruments that address HCSD**;

take an integrative approach to ensure that HCSD is included as a **crosscutting component** in all policy (and funding) instruments in a relevant and appropriate manner, at EU (e.g. Digital Strategy; Blue Growth, Integrated Maritime Policy…), global level (IMO, CBD, BBNJ..), and in regionals seas conventions and sea basin strategies and policy instruments;
  - Actively **engage in capacity development surveys and mapping exercises** (e.g. IOC GOSR, CD surveys, through national assessments); provide constructive advice where possible (data collection, analysis, dissemination) so as to **maximise impact** at the level of the policy objectives as well as **relevance at spatial scale** (e.g. Sea Basin);
  - Participate in **needs assessments and gap analysis** that are instrumental to define **focus on real needs** (e.g. between marine graduate training and Blue Growth sectoral skills gap analysis, identifying skills gaps and training needs); take a multi-stakeholder approach in assessments (see 6.2.);

- **Align standards in training** - across sectors, disciplines, skills, accreditation systems:
  - Support the development of **frameworks to define (core) standards** for training and HCSD;
  - Ensure **quality assurance and credit systems** (EQF, ESCO, MASTS Cert) take into account the special requirements of marine R&I and the specific aspects of the blue economy; e.g. a sectoral reference group for the blue economy under ESCO.
  - Collaborate in initiatives for **standardisation of institutional/national approaches for practical training** in marine science (including sea-going training) and transferable skills;
  - Contribute to the **creation of a central registry** and repository of marine R&I learning resources and training opportunities, such as the 'MarineTraining.eu' portal and its global component 'MarineTraining.org';
  - Acknowledge the **IOC-UNESCO 'Ocean Teacher Platform'** and its Regional Training Centres (RTCs) as the **reference for ocean training** in the context of the Agenda2030 and coordinating mechanism for ocean training in the context of the UN Ocean Decade challenge on the transfer of marine technology. The RTC in Oostende focuses on marine training in EU context.

- **Advocate for a core curriculum** of innovative marine education at European HEI
  - **Build on existing EU programmes** to reduce the disconnection between marine graduate training and ocean sustainability goals, including sustainable Blue Growth. Ensure graduates of marine sciences are recognized as a key potential contributor of ocean solutions to address societal challenges;
  - Advance the **European Higher Education Area for marine science and technology,** and promote the continued establishment of national HEI training networks/platforms for marine science and technology; explore the role of a Marine science and technology Knowledge Alliance (KA), marine/maritime Sector Skills Alliance (SSA) and/or Marine-KIC to this purpose;
  - Include **transferable skills training at early stages** of Masters or Bachelor-levels.
  - **Go for FAIR** – approaches to deliver FAIR and open science skills at university level; and the inclusion of skills and training of FAIR and open science into major European and national funding instruments.

6.2. Recommendations at BANOS Programme level

- **Take a systemic approach to HCSD at programme level:**
  - **Establish an HCSD ambassador to take forward the high level recommendations** as objectives of the BANOS HCSD Strategy (both above, and further below); The HCSD ambassador should align efforts with the objectives of other impact enabling instruments at BANOS Programme level (Open Science, Open Data, Open Innovation, Science Impact and Knowledge Transfer, Science Communication-Ocean Literacy-Citizen Science; see also BANOS CSA deliverables and Final reports on Tasks of 'Open Innovation' and 'Open Science').
  - **Capitalise on the BANOS experiences.** While building further on existing or past experiences, valorise lessons learned in the BANOS sea basin context to add value to EU and global approaches; establish mechanisms to articulate these as advise and support to national level
  - **Articulate with existing instruments, resources, programmes and networks:** i.a. but not restricted to BluePrint Alliances, Sector Skill Alliances, Erasmus+, EOSC, Marine Research Infrastructures, IOC-UNESCO and the UN Ocean Decade, EU HCD and Skills tools (EQF, ESCO, ECVET, EQAVET, section 2.5.). See available resources as documented throughout the current report and annexes (e.g. Table 11)
  - **Introduce HCSD project plans as cornerstone** of the BANOS HCSD Strategy: (in analogy with the Data Management Plans (DMP)): requiring a (mandatory) **draft HCSD plan with project applications** stimulates the

applicant to think and plan ahead, target the real training needs and identify the potential training outcomes, and facilitates a collaborative approach among internal and external training resources; **include metrics**, **assessments and feedback** opportunities for continued improving the HCSD Strategy.

- **Establish the enabling framework conditions for HCSD at the programme level**
  - **Develop guidance for the HCSD project plans,** as a crosscutting action in all BANOS project proposals: develop and provide templates, establish minimum quality standards and metrics, provide central platform for training resources, expertise and supporting services; HCSD plans should not be prescriptive and rather focus on valorisation and enhancing impact
  - **Take an integrative approach** – ensure that guidance for HCSD project plans align with R&I Impact enablers (see above)
  - **Pool efforts and resources**: explore common objectives and initiatives to gather forces in e.g. Summer Schools, Young Scientists' Club and resource platforms, Train-the-Trainers mechanisms
  - **Open by nature:** Establish sustainable forms of cooperation from the start of the programme, engaging with the private sector and triple helix needed in the joint design of training (during implementation and monitoring, and for smart assessment and evaluation) and to mobilise complementary resources (expertise, training material, funding; see also Annex IV).

• **Open and FAIR -** Ensure that all training material generated through BANOS projects is compliant with the requirements for open science and FAIR principles (see also BANOS Final report on Task 'Open Science' and 'Open Data' and recommendations).
  - **Use existing repositories** to submit and share BANOS training material and tools for HCSD
  - **Establish and/or support mechanisms for interoperability** and exchange of information and resources with key stakeholders in marine R&I capacity development (Marine Training, Ocean Teacher, SCOR…)

6.3. Recommendations at the call/project/action level

At individual call/project level, the HCSD plan will provide the main guidance for the practical implementation of the vision and strategic objectives of the BANOS HCSD Strategy. Guidance and templates for HCSD plans should not be prescriptive and should rather be seen as instruments to stimulate and promote the uptake of the strategic objectives of the HCSD Strategy. Developing detailed guidance or templates for these HCSD plans is not in the remit of the present Task 4.3. Further discussion within the consortium and main partners, to inform and advice decision-making processes at national level (national R&I and funding agencies) are *conditio sine qua non*. A number of criteria and elements that may be considered for inclusion in HCSD plan guidance/templates, include:

- **Target real training needs:** appraisal of specific training needs in terms of discipline-related skills (related to the 29 R&I themes under the 3 strategic objectives: Healthy Seas and Coasts, Sustainable Blue Economy, Human Wellbeing), of skills required in R&I Impact Enablers and of transferable skills; prioritise where needed

- **Conduct an analysis of the existing stakeholder landscape** of expertise and resources (input): use the category/type matrix and resource table 13 (Annex III) as a guidance; consider the wide range of resources, tools and formats including digital e-training and blended learning; assess opportunities for international collaboration

- **Outline roles, responsibilities and contributions** of stakeholders: who can contribute what resources, tools, content, trainers; use standards and agreed vocabularies; (see also annex IV, EMB 2018)

- **Define and plan impactful training resources and products (output):** outline how the project actions will/can contribute to the training landscape at international (sea basin)/national level, for the discipline-related, impact-enablers, and transferable skills

- **Use appropriate and internationally accepted standards, protocols** and vocabularies, standardised open source libraries; check interoperability of the metadata (descriptions) of the training resources so they can be included and accessed in open access training resource databases and repositories

- **Identify certification and consider accreditation and credits** and integration with academic and HEI courses (e.g. ETCS and qualification schemes)

- **Identify potential barriers and risk mitigation**

- **Identify outputs and impacts in agreed metrics** (see 6.2.)

- **Follow procedure guidelines:** procedures to be agreed (e.g. linear steps mechanism); collaborate with and follow guidance from existing training platforms (e.g. Ocean Teacher checklist and procedures; forum to collect feedbacks (e.g. BONUS Young Scientists Club) and build on existing templates such as course application forms, feedback and evaluation forms (e.g. BONUS Young Scientist Club, Ocean Teacher SCOR, JPI-Ocean, EUROFLEETS, ICES)

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Annex I: IOC Capacity Development Survey- Survey Questions list for IOC Focal Points

- Q1.1-Q1.4: (confidential information for user identification: not included in this report).
- Q1.5: How familiar are you with the following?
- Q1.6,1.7,1.8,1.9: Participation in IOC activities
- Q2.1: Please rank the most critical capacity development needs to build ocean science capacity (currently not available) in your country?
- Q2.2: How important are the following in terms of developing capacity in human resources (currently not available) in your country?
- Q2.3: In your opinion, how important are the following in terms of increased access to physical infrastructure for your country?
- Q2.4: If applicable, to what extent does the following help your country with regards to strengthened coordination with global, regional or sub-regional IOC communities and local networks?
- Q2.5: In your opinion, how useful are the following in terms of development of ocean research policies in support of sustainable development in your country?
- Q2.6: In your opinion, how useful are the following in terms of increasing visibility and awareness of ocean research in your country?
- Q2.7: In your opinion, how useful are the following in terms of mobilising sustained (long-term) resources in your country?
- Q2.8: Does your institution offer any of the following?
- Q2.9: Online data and information resources: How often do you use the following marine information portals in performing your essential functions?
- Q2.10 What other specific support can IOC global and regional programmes (GOOS, IODE, MPR, tsunami, etc.) provide to contribute to addressing your country's CD requirements?
- Q2.11: In terms of developing an overall Implementation Plan for the IOC CD Strategy (http://www.ioc-cd.org/strategy), are there any other CD efforts and supports not previously mentioned which you would like to see included?
- Q2.12: In the context of the UN Decade of Ocean Science for Sustainable Development for which of the following Ocean Decade Challenges are capacity development needs greatest in your country?
- Q2.13: In the context of the UN Decade of Ocean Science for Sustainable Development for which of the following Ocean Decade objectives are capacity development needs greatest in your country?
- Q2.14: Is Sustainable Development Goal 14 considered as a national priority in your country? Q2.15: If yes, how is this reflected in your national plans and policies? Q2.16: How would you rate the level of capacity available right now in your country to achieve SDG 14? Q2.17: How would you rate the level of capacity available right now in your institution to support the achievement of SDG 14 in your country?
- Q2.18: In your opinion, to what extent are the following aspects of capacity lacking to achieve SDG 14?
- Q2.19: Does your country or institution have a national ocean science capacity development strategy? Q2.20: If yes, please specify (provide URL if available online)
- Q2.21: Has your country carried out an ocean science capacity needs assessment? Q2.22: If yes, please specify (provide URL if available online).

SUBSET QUESTIONS

- 2A.1 Does your country have a "national coordinating body" to coordinate its cooperation with IOC? 2A.2 If no, then why not:
- 2A.3 Has your country designated an IOC national focal point for capacity development? 2A.4 If no, then why not:
- 2A.5 How do you rate national coordination on marine research in your country?
- 2A.6 How many Higher Education Institutions exist in your country?
- 2A.7 What degrees are offered by your HEIs (highest degrees or equivalent overall)
- 2A.8 How many students study marine related subjects in your country (estimate)
- 2A. 9 How many marine/coastal research institutions exist in your country?
- 2A.10 How many researchers are employed in the marine/coastal research institutions in your country?
- 2A.11 Is marine scientific research in your country linked to policy needs?
- 2A.12 Is HEI output of graduates linked to human resources needs of the national research institutions?

- 2A.13 Does the private sector in your country make use of the expertise available in HEIs or national marine research institutions?
- 2A.14 If occasionally or often, do they pay for the service?
- 2A.15 Is there an active policy to promote the use of local marine research/monitoring/management expertise in the private sector?
- 2A.16 If no, then should there be an active policy?
- 2A. 17 Does your country collaborate actively in IOC programmes? 2A. 18. If yes, please describe shortly:
- 2A.19 Does your country provide financial support to IOC capacity development activities (through projects, contribution to IOC special account or other financial channels)
- 2A.20 Does your country provide in-kind contributions to IOC capacity development activities (through hosting offices, providing national staff to IOC offices)
- 2A.21 Does your country provide in-kind support to IOC capacity development activities by providing expert time (to participate in workshops, steering groups etc.)
- 2A.22 Will Covid19 have an impact on your overall collaboration in IOC capacity development activities in 2021-2022
- 2A.23 Will Covid19 have an impact on your support (financial, in-kind) to IOC capacity development activities in 2021-2022

Annex II: SCOR overview of Capacity Building Approaches for Ocean Science, Observations, and Data/Information Management

Developed countries have well-established educational systems, but many countries in developing regions of the world are still setting up sustainable education systems. Several international organisations carry out a range of complementary capacity building and development activities and have begun to coordinate their efforts. SCOR offers webpage service to the community of scientists concerned with building capacity for ocean research, observations, and data/information management. The web-service provides links to organisations with capacity development pages, or alternative information provided by SCOR.

Matrix of Capacity Building Approaches for Ocean Science, Observations, and Data/Information Management

	IAEA	IFS	INOC	IOC	IOI	NAM	PICES	POGO	SCOR	START
Grants to attend meetings	X	X		X			X		X	X
Grants for short-term training in ocean obs	X		X					X	X	
Grants for short-term training in ocean research			X			X				
Grants for training in data and information mgmt			X	X						
Summer Schools			X	X		X	X		X	
Training for professionals	X	X	X	X			X			
Training through research	X	X	X	X						X
Bursaries in developing country institutions								X		
Ship-board experience			X	X				X		
Visiting Professorships								X	X	X
Centers of Excellence in oceanography training				X				X	X	
Leadership training				X	X					X
Distance Learning				X						
Internships in International Secretariat				X			X			

IAEA = International Atomic Energy Agency
IFS = International Foundation for Science
INOC = Inter-Islamic Science and Technology Network on Oceanography
IOC = Intergovernmental Oceanographic Commission
IOI = International Ocean Institute
NAM = Non-Aligned Movement Science and Technology Center
PICES = North Pacific Marine Sciences Organization
POGO = Partnership for Observation of the Global Oceans
SCOR = Scientific Committee on Oceanic Research
START = The SysTEM for Analysis Research and Training

Annex III: Categories of HEI-Training and Education tools and approaches

Table 13. Overview of Categories of HEI - Training and Education tools and approaches, as screened in the desktop study and interviews with strategic partners. The figures in the field refer to the number (quantity) of examples screened. The full list of initiatives and references is included in Annex III.

CATEGORY	Academia	Science	Policy	Co-design	Company
DESCRIPTION	organised solely by or through HEIs and exclusively for students/PhD/Postdoc	organised by scientific institutions (possibly in collaboration with HEIs) and/or aimed at a scientific audience	organised by policy-informing bodies and/or aimed at scientists, policy makers, professionals	co-designed by research and industry actors	organised by a company and aimed at (potential) workforce
Accredited post-secondary degrees - HEI and vocational	CPMR - Vasco da Gama: Master Programme			BBMBC - Blue Biotechnology Master for a Blue Career	Pisces Learning Innovations - Case Studies: Aquaculture and Fisheries
	EMBRC - IMBRSea International Master in Marine Biological Resources			ASSESS - Advanced Master in Safety, Environment and Security at Sea	
	IMarEST - MLA College			BLUE SMART - Master in Sustainable Management of Aquatic Ecosystems	
	mtec@work - MSc and certificates in Marine Technology			CETBC - Cooperation in Education and Training for Blue Careers	
				SMMI - Centres for Doctoral Training	
				Entekra - Career Traineeship in Architectural Technology and Design	
				German dual education system	
				Making the Most of Masters - Work Based Projects	
				MarLEM - Joint Master Program in Maritime Logistics Engineering and Management	
Doctoral degrees and training	BONUS	BONUS		IDCORE - EngD in Offshore Renewable Energy	
	JPI Oceans	JPI Oceans		MSCA - ITN: European Industrial Doctorates	
	JPI Climate	JPI Climate			
	MASTS - Postgraduate Certificate in Researcher Professional Development for Marine Science and Technology	Marine Institute - Eoin Sweeney Fellowship Award			
	SUPER Doctoral Training Partnership	MSCA - Innovative Training Networks			
Infrastructure available for training - shiptime, access to	CoMET - Internationally Competitive Maritime Education for Modern	EurOcean - EUROFLEETS training activity		BBA - Blue Demo Network	

marine stations and labs, computational resources	Seagoing and High Quality Port Services				
		IOC-UNESCO		ASSEMBLE Plus - Transnational acces	
		Marine Institute - Ship-time Programme		AQUAEXCEL^{2020} - Transnational Acces	
		SMART - Training Through Research Surveys		BlueBRIDGE - Competitive Call for SMEs	
		SMART - Science@Sea CPD Courses		MATES: Offshore renewable energy crash courses	
		Ocean Training Partnership - Shipboard training			
		Eurofleets+ - Floating Universities			
		Eurofleets+ - Blue Skill Labs			
		EuroMarine & EMBRC - Join call for access to EMBRC infrastructure			
Mobility support - for students, professionals, lecturers	Fulbright	EuroMarine - Young Scientist Individual Fellowship Programme	JPI Climate - ERA4CS exchange action	CPMR - Vasco da Gama: Maritime Erasmus	
	Erasmus+ - Erasmus	IOC-UNESCO		ASSEMBLE Plus - Transnational acces	
	Erasmus+ - Erasmus Mundus Joint Master Degrees			AQUAEXCEL^{2020} - Transnational Acces	
				MATES: Green Move	
Internships		IOC-UNESCO		Marine Institute - Irish Seafarers Education Assistance Scheme Programme	
				Entrefish - Entrepreneurship for new employment and new skills in fishery's and aquaculture's SMEs	
				SMMI - Knowledge Transfer Partnerships	
				MASTS - Internships	
Summer schools	MASTS - Graduate Retreat	JPI Climate - ERA4CS Summer School	CPMR - Vasco da Gama: Summer School	UGent - Blue Growth Summerschool	
		EuroMarine - Internal (summer) courses	IFLOS - Law of the Sea Summer Academy	MATES: Summer school	
		EurOcean - RISC-KIT Summer School	AORAC-SA & AANChOR - All-Atlantic Ocean Youth Ambassador Summer School		
		IOC-UNESCO - Courses overview			
		IDCORE - CPD Courses in Offshore Renewable Energy			

Short training courses - including workshops, seminars, excursions		HELCOM	HELCOM	CPMR - Vasco da Gama	RINA - Marine services: training
		ICES - Training Programme	Barcelona Convention - SWIM-H2020 SM training activities	ASSESS - Upskilling Programme	Katapult Ocean - Accelerator
		BONUS - YSC training events	Bucharest Convention	ASSESS - Training the Trainers	Hatch - Accelerator Programme
		EuroMarine - Internal (summer) courses	ICES - Training Programme	Entrefish - Entrepreneurship for new employment and new skills in fishery's and aquaculture's SMEs	
		IOC-UNESCO - Courses overview	EurOcean	XRAq - Activitats de Formació	
		Marine Institute - Explorers Education Programme	Institute of Maritime Law - Southampton Maritime Law Short Course	AQUAEXCEL^{2020} - Face-to-face Courses	
		Eurofleets+ - Blue Skill Labs	COLUMBUS - Internal and external training courses	MATES: Freeboard - Hands-on training in modular shipbuilding	
		IMarEST - Training Courses		MATES: Green Maritime Hackathon	
		JRC - Training programmes		MATES: Innovation Manager course	
E-learning and blended learning - webinars, slides, courses, moodles, MOOCs, distance learning, VREs	CPMR - Vasco da Gama: Master Programme	BONUS - YouTube channel	Barcelona Convention - H2020 Initiative training material	BLUE SMART - E-learning course	
	IMarEST - MLA College	JPI Climate - ERA4CS webinars	Belmont Forum - e-I&DM Resource Library: Action Theme 4 Capacity Building	Entrefish - Entrepreneurship for new employment and new skills in fishery's and aquaculture's SMEs	
	mtec@work - MSc and certificates in Marine Technology	IOC-UNESCO - OceanTeacher Global Academy		MENTOR - E-Learning Courses	
		Belmont Forum - e-I&DM Toolkit		Blue Generation Project	
		Marine Institute - Explorers Education Programme		Aqua-tnet - AquaCase 3.0	
		Marine Institute - Irish Maritime Development Office - Follow the Fleet		AQUAEXCEL^{2020} - Distance Learning Courses	
		Eurofleets+		BlueBRIDGE - Virtual Research Environments	
		EuroMarine - Mentorship platform		MATES: ED2MIT - Education and Training for Data Driven Maritime Industry	
		OceanMOOC - E-learning modules		MATES: MOOC - Upgrade of traditional shipbuilding tools to 4.0 industry	
		Ocean School		MATES: Offshore renewable energy crash courses	

		MASTS - Weekly YouTube webinars		Sea of Experience - Establishment of Eastern Mediterranean Regional Network: pooling, sharing, development of innovative face-to-face and digital training/mentoring tools for the maritime sector	
CoE, network, funding scheme - with focus on training or establishing a formal qualification framework		NF-POGO - CoE in Observational Oceanography	CTP - Setting the Standard for Sustainable Fishing Training	EIT - Knowledge and Innovation Communities	
				Erasmus+ - Sector Skills Alliances	
				Erasmus+ - Knowledge Alliances	
				EASME & EMMF - Blue Career projects	
				MENTOR - Blue Career Centre of Eastern Mediterranean and Black Sea	
				ECSEL JU - Lighthouse Initiatives	
				EKLIPSE - Calls for the organisation of Capacity Building Events	
				MarENet - Atlantic Maritime Ecosystem Network	
				Nautilus - Education & Certification Framework for Blue Career in Water Sports Tourism	
				ScienceDIVER - Cross-sectoral skills for the Blue Economy labor market	
Conferences - and symposia, with HCSD as objective		ICES - Annual Science Conference	BONUS - BONUS Symposia	MENTOR - Blue Career Fair	
			EMB - EurOCEAN		
			COLUMBUS Annual Conference		
Advice - studies and recommendations on HCSD	EMBRC - Marine Training Platform	EuroMarine - Call and event portals	ICES	EUA - DOC-CAREERS	Eunomia - Green Jobs in the Blue Economy: A Bottom-up Approach
	EUA - Council for Doctoral Education	EurOcean - Call, event and job portals	CPMR	USWE Shipbuilding Sector Skills Alliance	
	LERU - Advice Papers on online learning, doctoral training, student entrepreneurship	IOC-UNESCO - Course and event portal	JPI Oceans	SKILLSEA Maritime Transport Sector Skills Alliance	
	EMBRIC - Training Catalogue	Marine Institute - Irish Maritime Development Office - Maritime education and job portal	EMB - Future Science Brief, Navigating the Future	BlueEDU Aquaculture Sector Skills Alliance	
		Science Connect - Career Tracking Survey of Doctorate Holders	IOC-UNESCO - IOC Group of Experts on Capacity Development	SUBMARINER Network - Baltic Blue Biotechnology Alliance: training opportunities portal	
		Aqua-tnet - Education, mobility, internship and job portals for aquaculture	Belmont Forum - e-I&DM Action Theme 4: Capacity Building	MATES Shipbuilding and Offshore Renewable Energy Blueprint for Sectoral Cooperation on Skills	

			BLUEMED CSA - Assessment on improving human resources for Blue careers		
			Cedefop - Skills Forecast and other tools		
			EuroMarine - Strategic Agenda on Enhancement of Human Resources to support Blue Growth sectors		
			EASME - Study supporting a possible network of maritime training academies and institutes in the Mediterranean Sea basin		
Classroom visits		EurOcean	Push - Live engagement sessions		
		Marine Institute			
Young Scientists Clubs-Networks		BONUS - Young Scientists Club	AORAC-SA & AANChOR - All-Atlantic Ocean Youth Ambassadors		
		EuroMarine - OYSTER			

Transferable skills - leadership, entrepreneurship, communication, grant writing etc.

Continued Professional Development

Train the trainer

Coaching of startups, new SMEs

Annex IV: Overview of key actors in the marine landscape and their (potential) role in HCSD

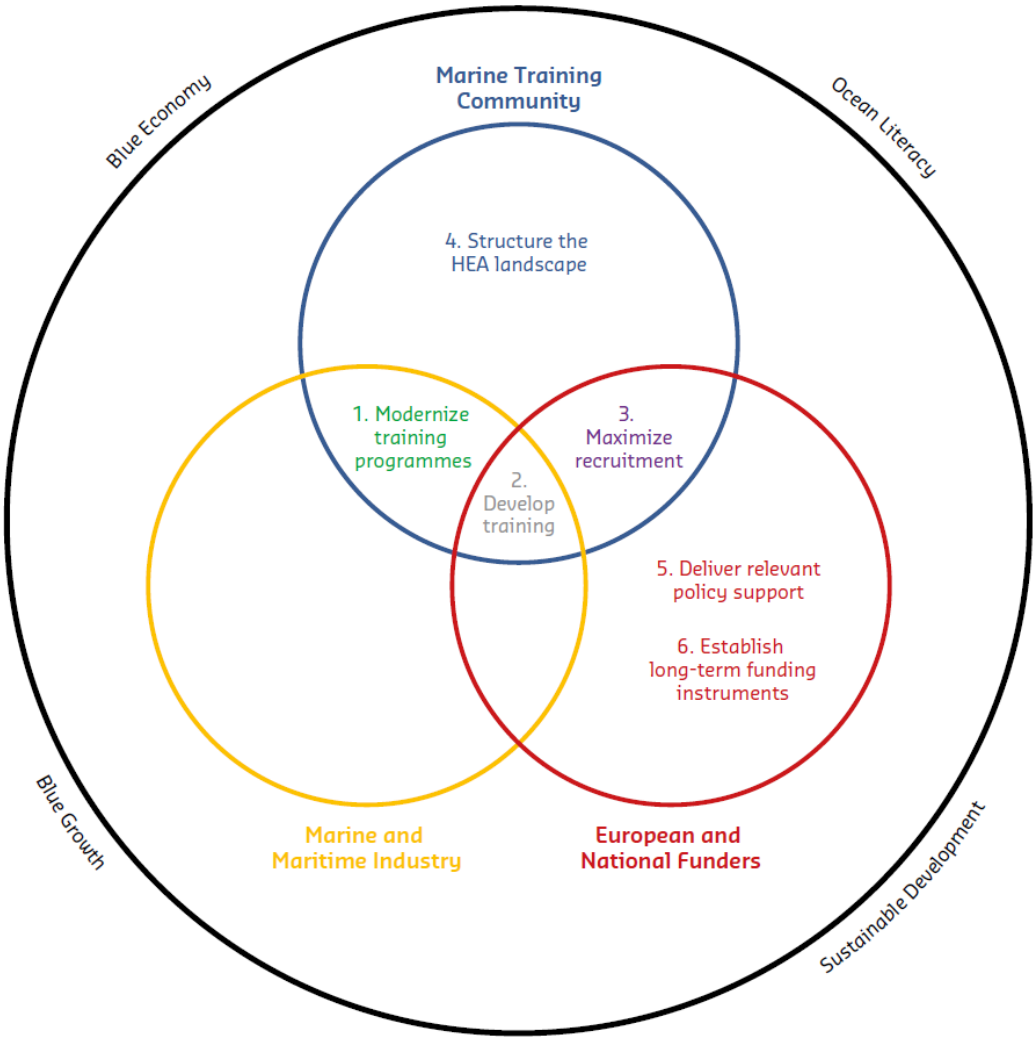

Figure 6: "Key recommendations for marine graduate training showing key actors set within the wider marine landscape."(Vincx et al. 2018)